DESIGN OF THE GPS TRACKING SYSTEM FOR MONITORING PARAMETRIC VEHICULAR MEASUREMENTS WITH ACCIDENT NOTIFICATION VIA SMS FOR SAUDI GERMAN HOSPITAL

by

Christopher T. Delarmente
Juris Lan H. Hinanay
Charisma Ann M. Mendoza
Myra A. Tolosa

A Design Report Submitted to the School of Electrical Engineering, Electronics Engineering, and Computer Engineering in Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Computer Engineering

Mapua Institute of Technology
December 2011

Approval Sheet

Mapua Institute of Technology

This is to certify that we have supervised the preparation of and read the design report prepared by **Christopher T. Delarmente, Juris Lan H. Hinanay, Charisma Ann M. Mendoza, and Myra A. Tolosa** entitled **Design of the GPS Tracking System for Monitoring Parametric Vehicular Measurements with Accident Notification via SMS Saudi German Hospital** and that the said report has been submitted for final examination by the Oral Examination Committee.

Engr. Dionis A. Padilla
Design Adviser

As members of the Oral Examination Committee, we certify that we have examined this design report presented before the committee on **November, 2011**, and hereby recommended that it be accepted in fulfillment of the design requirements for the degree in **Bachelor of Science in Computer Engineering.**

Engr. Janette C. Fausto
Panel Member

Engr. Gorgonio C. Vallestero II
Panel Member

Engr. Joshua B. Cuesta
Chairman

This design report is hereby approved and accepted by the School of Electrical Engineering, Electronics Engineering, and Computer Engineering in partial fulfillment of the requirements for the degree in **Bachelor of Science in Computer Engineering.**

Dr. Felicito Caluyo
Dean, School of EECE

ROLES AND RESPONSIBILITIES OF GROUP MEMBERS

Christopher T. Delarmente

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ACKNOWLEDGEMENT

The completion of the Design Project, GPS TRACKING SYSTEM FOR MONITORING VEHICULAR ACTIVITIES WITH ACCIDENT NOTIFICATION VIA SMS would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this study.

Engineer Ayra G. Panganiban, who gave support and supervision that help the development of our design project, and for her patience and persistent encouragement to complete this study.

Our adviser, Sir Dionis Padilla for giving his time to check on our progress and sharing valuable insights in the relevance of the study to basic education not just in the technology sector.

Engineer Joshua B. Cuesta for enlightening our path toward the search for a proposal, without him we would not have found our design topic, as well as the advices and recommendation for our design prototype.

E-Gizmo for providing a good offer of the SMS, VDIP and GPS modules and that we used in the project.

With the support our friends especially our families, we had surpassed the struggles.

The Almighty God who gave the advocates the knowledge and strength, patience, perseverance, courage, and for the answered prayers to complete this design project

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ABSTRACT

The Global Positioning System has now become a popular and widely used tool in terms of the application of tracking a certain target and locating its position. The main objective of the design is to develop a monitoring device that shall record parametric developments of the vehicle during its time on the road, and shall be stored on the memory built on the car. The designed device consists of the microcontroller, the accelerometer, the VDIP module, the GSM module, and the GPS module. A windows GUI application shall be included that will serve as the medium for accessing the data and to view its contents including the location with the help of Google Maps. The designed device shall have an SMS alert feature that will be triggered once an accident has occurred. Assessment of the device showed that the device records data and alerts successfully in an acceptable timeframe, when the vehicle occurred in an accident such as tilting and sudden stops, albeit with issues regarding GPS signal strength on bad weather conditions. From the results, the designers concluded that a device capable of recording vehicle activities and alerting using SMS is successfully developed.

Keywords: GPS module, GSM module, VDIP Module, Database, SMS, Vehicle Monitoring

Chapter 1

INTRODUCTION

Location is a very important piece of information. Knowing one's location helps know a person/object's exact place of setting. When the researchers talk about location, they are more particular with the place in which the target is, at the same time they are curious on the speed and direction the target is going in that specific location and more importantly where is that location.

CUSTOMER

Anyone who has a vehicle of any kind will find that there are plenty of reasons for wanting a GPS based tracking system installed. The tracking systems available to consumers are obviously less sophisticated than what a fleet manager would use but one may still be amazed at what they can do. If someone is concerned about their car, auto, van or truck being stolen then if it was tracked they would now know where it was if it went missing. A parent may want to install one in the car that their kids use so they can monitor not only where they go, and how long they stay there but also how fast they go. Recent surveys have suggested that the driving speed of their children is the major concern of parents when their kids are behind the wheel of a car or even if someone else is driving. If their kids are in the car they could be at risk. Using a tracking system could even help a parent to teach their kids to drive responsibly. If they are employers then they may want to monitor where their company cars and when their employees are driving them to ensure that they don't incur extra

costs due to unofficial non-company travel or other non-business purposes. These are the common scenarios that can happen when someone wants to know what exactly is happening with the vehicles that they use, and most certainly want to know when, how and why it was used.

STATEMENT OF THE PROBLEM (NEED)

Common knowledge is that most business company with delivery services often have complaints about on delivery time problems with their clients, or most oil companies sometimes, more often than not, that they might have someone delivers oil tanker's illegal transactions without their knowledge, or mostly on Bank Company that runs their own Armored Car. In this situation the owner is unaware whether the driver of the armored car is trustworthy of delivering their money to their respective patrons, or maybe there are some ordinary public vehicles that travel in isolated places in which help is out of reach in case an accident happens and information about accidents is slow or sometimes never reaches to the public that an accident has occurred, and another problem is the overwhelming car napping in the current setting, here when a vehicle is stolen it is sometimes hard to track down the vehicle at once.

Knowing where someone is different from knowing what they are doing in such place. Thus, most industries and owner of vehicles are very particular on where their cars are traveling. The illegal use of their vehicle sometime enters their mind and therefore wonders whether the utilization of their vehicles has already involved in an illegal transactions other than their own business. Another

usefulness of the location is that when accidents occur, the exact place of the accident can easily be accessed by knowing the shortest route to the accident site. This is where the application of the GPS comes in. Knowing the location of the vehicle can help deduce these doings, plus will help observe the vehicle's parametric standing.

SOLUTION

GPS or Global Position System is a known device that functions as a way of knowing one's exact location and at the same time tracks down the target's taken route starting from its origin up to its destination. From here the user can only become aware of the person's location and taken route but not the exact activity of the target. Mostly, the GPS system is often used into vehicles and monitoring their location, but not the vehicles activity. Researchers, who had already solved the problem on vehicular tracking, use the GPS in order to keep record of which route was taken and knowing starting and ending point of the vehicle. Based on previous reviews on GPS, the functional advantage of this device uses satellites that triangulate the position of the target. These Satellites revolve around the planet calculating the disposition of the target's location, knowing such information, it therefore generates the coordinates of the location thus throwing these values into a server and locating the target all at once. GPS tracking system is used in car tracking devices for tracking data about a car's location, direction, speed etc. GPS tracking device comes in handy for transport

companies as it enables them to track their vehicles and ensure timely delivery of goods and services.

Objectives

The objective of the design is to be able to monitor the vehicle's parametric data, such as the direction, location and speed. By doing so, the driver or owner of the vehicle is fully aware of how he is utilizing his car. Another objective of the design mainly focuses on recording and monitoring the parametric data, which are stated above, before and after an accident occurs. The recorded data will be stored as a text file named "log" in the USB drive mounted on the device. With this information, the users can simply analyze why the vehicle had ended up in an accident, from here they can conclude whether the vehicle had sped up or had simply gone out of course. Another objective of the design is to be able to send early alert notification to the server when an accident happens. Most accidents that happen in isolated areas eventually receive help a few hours later; but with the design, the SMS feature is triggered at once and sends the message in order to get untimely help from those who are near the accident site. Another objective is that by monitoring frequently the places of which the vehicle has gone; the user is able to get the analysis of the place. This simply answers the question why is the vehicle in that place when it is not supposed to be there.

Constraints

GPS system is limited to areas that are known and on-land only; when the vehicle goes under a tunnel the GPS could no longer detect it. The USB device mounted into the vehicles records the data of the vehicle's location, speed, and direction thus the capacity of the USB is depended on it. When the capacity of the USB's storage is low the amount of recorded activity varies with it. The SMS feature is also dependent on both the Signal and the Provider. When the accident occurred in an area that has absolutely no signal, the SMS feature won't be able to send the message to the server.

Impact

By this innovation, the Company is able to secure their products/produces in terms of delivery services. When a company knows that their employees are trustworthy enough to do the job, they are much more secured in letting them handle their product/produce. And also the company is able to monitor their employees' activity even when they are on the road. This innovated tracking device system also helps us solve the cause of common car accidents by letting us know exactly what happened before and after the accident occurs. Another benefit is the updating of information. Sometimes in isolated area where accidents sometimes happen, help response come in late to save a life, by this design we use the GPS and SMS technology to be triggered once the accident happens and send the information immediately to the server to alert that help is needed.

The tracking of vehicles by means of GPS receivers has recreational, economical and safety benefits in society. GPS equipped rental cars can provide tourists with driving instructions to tourist sites, and accommodation. This can reduce stress levels whilst on vacation. Truck drivers are now being made aware of upcoming low bridges using GPS and digital maps. This combined with awareness of traffic jams, and suggestions of alternative routes allows for the cheaper delivery of goods. Police cars, ambulances and fire trucks are also increasingly being fitted with GPS. This allows emergency operators to direct the closest units to an emergency, potentially saving lives.

With GPS technology, the routes of the test persons are linked up with the purpose of the journey. In such a way, a database can be created where the proportion of trips for shopping can be separated from other journeys. One can then also see how common it is for journeys to shops to be combined with other journeys, for instance journeys to and from work, to and from school or to and from recreational activities.

Differentiation

Most tracking device system mainly concentrates on the location of the vehicle or target being tracked down. The location itself is a huge piece of information that lets the person know where the target is and where the target tends to go, but in the design, the target's exact location is known and on how fast the target and the direction of driving is heading to. Another difference here is that a device shall be installed into the vehicle using the common USB

technology in which this USB contains a specific text file format data that basically records the location, speed, and direction of the vehicle. The device installed uses a program that shall record the parametric data of the vehicle and the information about the vehicle's status that occurs on this specific time. The data are just text files that list everything down from the exact location to the vehicle's direction and speed to know whether the driver has done his job right or had lying down on the job.

BENEFITS

So as to solve the WH questions of the vehicles' usage, the researchers had come up with a design that would not only monitor the vehicle's location but would also monitor the speed and direction of the car. Monitoring starts when the vehicle has started its engine. All the recorded information will be saved into the USB device mounted on the vehicle, and later be retrieved in order to analyze the vehicle's status on the road. By monitoring the vehicle's data and location, one can be able to solve common problems that are experienced today, such as the overwhelming car napping crimes that increase by 0.5 percent per year. By this design, users can easily track down the stolen vehicle's site. Car tracking devices are particularly very useful in tracing stolen cars. If installed in a car, the police can trace back the stolen car and retrieve it within a short time. Theft and crime have become everyday news. Car theft is one of the major crimes that is getting worse year after year. Another problem that can be solved by the design is the early notification when an accident occurs. Most accidents

that happen today tend to give as a very slow update about the occurrence of the accident, with the design once the accident happens, the SMS feature of the device mounted into the vehicle is triggered and sends an immediate message to the server.

DEFINITION OF TERMS

1. GPS – known as Global Positioning System, is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S.

2. GSM - (Global System for Mobile communication) is a digital mobile telephony system that is widely used in Europe and other parts of the world.

3. Accelerometer - is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer.

4. LCD(Liquid Crystal Display) - a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals(LCs). LCs do not emit light directly.

5. Microcontroller - an IC (integrated circuit, or a black chip thing with pins coming out of it). However it is very common to add additional external components, such as a voltage regulator, capacitors, LEDs, motor driver, timing crystals, rs232, etc to the basic IC. Formally, this is called an augmented microcontroller. But in reality, most people just say 'microcontroller' even if it has augmentation.

6. SMS (Short Message Service) - a method of communication that sends text between cell phones, or from a PC or handheld to a cell phone. The "short" part refers to the maximum size of the text messages: 160 characters (letters, numbers or symbols in the Latin alphabet). For other alphabets, such as Chinese, the maximum SMS size is 70 characters.

7. Remote Controlled Car - is self-powered model car or truck that can be controlled from a distance using a specialized transmitter. The term "R/C" has been used to mean both "remote controlled" and "radio controlled", where "remote controlled" includes vehicles that are connected to their controller by a wire, but common use of "R/C" today usually refers to vehicles controlled by a radio-frequency link

8. Accident - an undesirable or unfortunate happening that occurs unintentionally and usually results in harm, injury, damage, or loss; casualty; mishap: automobile accidents.

9. GIS - geographical information science or geospatial information studies is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data.

10. Server - is a computer program running to serve the requests of other programs, the "clients". Thus, the "server" performs some computational task on behalf of "clients". The clients either run on the same computer or connect through the network.

11. USB - is a data storage device that consists of flash memory with an integrated Universal Serial Bus (USB) interface. USB flash drives are typically removable and rewritable, and physically much smaller than a floppy disk

12. Text File - is a kind of computer file that is structured as a sequence of lines of electronic text. A text file exists within a computer file system.

13. Visual Basic (VB) - is the third-generation event-driven programming language and integrated development environment (IDE) from Microsoft for its COM programming model. Visual Basic is relatively easy to learn and to use.

14. System Monitoring - systems engineering is a process within a distributed system for collecting and storing state data.

15. Alert Notification - Alert is a colloquial term used to define a machine-to-person communication that is important and/or time sensitive. An alert contains user-requested content such as a reminder (important), a notification (urgent), and ultimately an alert (important and urgent). Alert notification is the delivery of alerts to recipients.

16. Telecommunication - Telecommunications is a general term for a vast array of technologies that send information over distances.

17. Sensor - Telecommunications is a general term for a vast array of technologies that send information over distances.

18. Network Packet - a packet is a formatted unit of data carried by a packet mode computer network. Computer communications links that do not support

packets, such as traditional point-to-point telecommunications links, simply transmit data as a series of bytes, characters, or bits alone.

19. Light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting.

20. Antenna - is an electrical device which converts electric currents into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter applies an oscillating radio frequency electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves).

21. SIM - is an integrated circuit that securely stores the service-subscriber key (IMSI) used to identify a subscriber on mobile telephony devices (such as mobile phones and computers)

Chapter 2

REVIEW OF RELATED LITERATURE

The significant power of the GPS technology had become a huge aspect in society's monitoring systems. Knowing one's location is a very important factor in terms of observing a specific target. When this information is obtained, tracking it down is easy as drawing a line from one point to another. By tracking down the point from which the target had come from, up to the point of which it shall stop, is an easy access since the Global Positioning Satellite System makes this easier for observers to monitor the vehicles course.

Global Positioning System

GPS or Global Positioning System provides two levels of service, Standard Positioning Service (SPS) and Precise Positioning Service (PPS). The SPS is a positioning and timing service that is available to all GPS users on a continuous worldwide basis. SPS is provided on the L1 frequency (1575.42), which contains the navigation data message and the SPS code signals. The PPS is a highly accurate military positioning, velocity and timing service which is available to users authorized by the Department of Defense**.** Since its inception in 1978, GPS has fast become the most popular satellite aided navigation system used worldwide. Many industries, such as civil aviation, shipping and agriculture, have become quite dependent on this service.

GPS or Global Positioning System as according to the article of Jay Warrior, Eric McHenry, and Kenneth McGee, "They Know Where You Are" written

in January 2003, that the first development of the tracking system was used for military purposes. The constellation of U.S. military satellites that are used to guide everything from bombs to ordinary passenger cars, to monitoring assaults had made a huge development for national security against terrorist attacks. In Europe, the use of the GPS played a huge role in terms of cellular communication technologies. The technology depends on a form of triangulation: it requires at least three cellular base stations to receive a signal from the wireless handset, and then computes the location from the differences in arrival times of the three signals.

Through this technology, the military is able to counter these attacks by using the enemies' location against them. For communication, the benefits of location technology aren't limited to subscribers—it will also help wireless carriers improve their systems, by making every enabled handset an instrumentation probe. Signals played an important part since they are called "hints", as according to the article, these hints suggest the GPS satellites that will give the quickest fix on the position. These hints are particularly necessary when the phone is indoor or the enemy is underground and GPS reception is more limited.

The concept of the GPS mainly applies to monitoring people and knowing their locations. In the paper Design and Implementation of a Mobile Devices-based Real-time Location Tracking by Hyo-Haeng Lee, In-Kwon Park, and Kwang-Seok Hong, this paper proposes a real-time location tracking system using a GPS module for different mobile devices and multiple users. It focuses on

the management and observation of a majority of people can be foretold. The development was made so the user may acquire and manage location information of specified subjects, who require individual care in real-time. Such users include those requiting specific protective measures, children, and the elderly. In applications to vehicle, this is also the same, the researchers are to use this basic concept and apply in cars so as to keep track of the vehicle n terms of security and reliability.

Based on research, navigation enables a user to process his current location based on GPS data and travel to his desired location, also based on accurate GPS data. Any user with a working GPS receiver can navigate to a particular destination, whether traveling on foot, by automobile, by airplane or by ship. Time is the fourth dimension that GPS is set up to provide, by synchronizing each GPS receiver to the GPS satellites to provide accurate time to the user.

Global System for Mobile Communications (GSM) and SMS services

Mobile services are widely used today. In the paperDesign and Implementation of a Mobile Devices-based Real-time Location Tracking by Hyo-Haeng Lee, In-Kwon Park, and Kwang-Seok Hong, the use of mobile is to track and to identify the location of objects in real time. They may use simple, inexpensive nodes (badges/tags) attached to or embedded in objects and devices (readers) that receive the wireless signals from these tags to determine their location. One of the mobile services that can be accessed is the GPS feature. The paper proposes

a real-time location tracking system using a GPS module for different mobile devices. Several users may be required to manage and to observe most of the subjects (people) being monitored. Another mobile feature adopted is the GIS that has been implemented on many mobile devices. With the widespread adoption of GPS, GIS has been used to capture and to integrate data in the field. GIS APIs are designed to manage GIS data for delivery to a web browser client from a GIS server. They are accessed with a commonly used scripting language such as VBA or JavaScript.

In another paper, Design and Implementation of Real Time Vehicle Tracking System by Muhammad Adnan Elahi, Yasir Arfat Malkani2, and Muhammad Fraz, written and proposed in 2007, After collecting positioning data, it is transmitted using some kind of telemetry or wireless communications systems. GSM is the most common used service for this purpose.

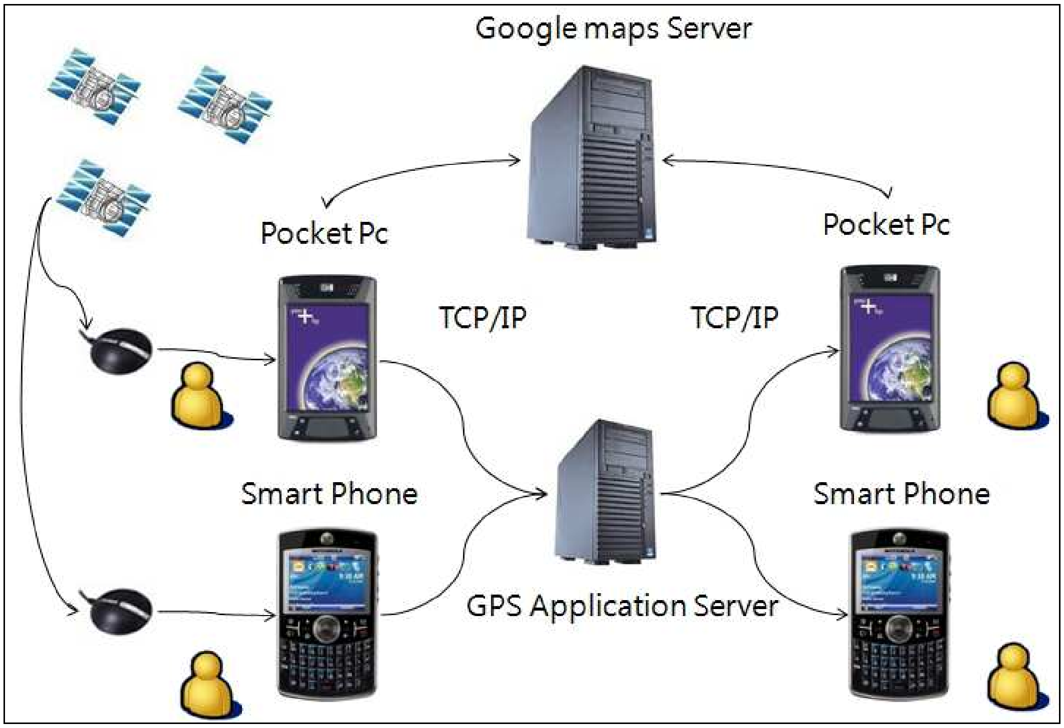

Figure 2.1

Architecture of the mobile device based real-time tracking system

The figure shown above, mainly explains how the GSM works with the GPS and GIS application. The user receives desired information from the mobile device, mounted with a GPS receiver, to access the location based service. When the client transfers longitude and latitude received from the GPS receiver to the GPS application server via TCP/IP, other mobile client users convey location information data, accessing the GPS application server.

As reference to the study, the researchers shall require a GPS application server in mobile devices for wireless communication for the SMS alert system. Based from the reference, if a mobile device user shall acquire the GPS location information when the server had sent it, the acquired location information is transferred to the GPS application server after transforming the coordinates.

Then other mobile device users access the multi-user real-time location information from the GPS application server. The use of the information shall be used for the purpose of the accident alert system.

Geographic Information System

A Geographic Information System (GIS) is any system to capture, store, analyze and manage data and associated attributes that are spatially referenced to Earth and Location Based Services (LBS). GIS are information services accessible via mobile devices through the mobile network that utilize the location of the mobile device. GIS analysis software takes GIS data and overlays or otherwise combines it so that the data can be visually analyzed. It can output a detailed map, image or movie used to communicate an idea or concept with respect to a region of interest. This is usually employed by persons who are trained in cartography, geography or a GIS professional, as this class of application is complex and takes time to master. The software transforms raster and vector data sometimes of differing data type, grid or reference systems, into one coherent image. It can also analyze changes over time within a region.

The application of GIS in the research is to determine the tracking route of a targeted vehicle. The research shall use the concept of the GIS as reference for the software development only. Other software for the vehicle monitoring and tracking shall be developed further during the research.

Vehicular Tracking

According to a review, using GPS Tracking for Vehicle and Personnel Management in Industries on The Rise by Vaishnavikna Pathak, those industries which are involved in transportation, logistics, manufacturing, etc. have a number of vehicles that are on the move or transport goods to the different points of sale. Even, they would require the raw materials to be brought in from the distant areas, and they have to be brought in perfect time. It is also required that the vehicles in the fleet are to be monitored regularly about their reach and return on time, so that the next travel plan and consignment can be delivered. Personnel tracking help in reducing the labor and unnecessary haggling with clients by remaining in the uncertain cloud. The GPS tracking device that is fitted in these vehicles can easily convey the location and the approximate arrival time.

In another research paper, Design and Implementation of Real Time Vehicle Tracking System by Muhammad Adnan Elahi, Yasir Arfat Malkani2, and Muhammad Fraz, written and proposed in 2007, tracking was to serve the main purpose of navigation for location-based applications. Real time vehicle tracking system is successfully implemented using SMS of GSM network, and GPRS as transport channel to achieve the desired properties of Automatic Vehicle Location (AVL) system. The paper covers the hardware and software design of devices developed to determine and transmit the vehicle's information, such as its location, to the remote Tracking Server. Tracking Systems aid in determining the

geographic positioning information of vehicles, once collected it will then transmit it to a remotely located server.

In the same paper, the vehicle's location is determined using GPS, while the transmission mechanism can be satellite, terrestrial radio or cellular connection from the vehicle to a radio receiver, satellite or nearby cell tower. There may also exist some other alternatives for determining the location in the environments where GPS signal strength is poor, such as dead reckoning, i.e. inertial navigation, active RFID systems or cooperative RTLS systems.

In the IEEE paper, GPS Based Marine Vessel Tracking Device by Glenford A. McFarlane and Joseph Skobla, satellite navigation has started to expand into other areas such as recreation, security, and emergency response. Without any reservation, this form of position acquisition is here to stay and can only get better. In the paper, the goal of the project is to provide GPS tracking solution for fishing boats. The processing unit is equipped with two communication ports one dedicated for the GPS receiver and the second for radio link.

Such monitoring of the vehicle's time is depended on the vehicle's activity, whether the target had slowed down or sped up, or has entered a traffic area or just simply halted momentarily in an isolated area. This is where the study comes in; monitoring the vehicles' events helps utilize this information in order to maximize the industries demands and requirement in terms of delivering trade and monitoring.

Vehicular Monitoring

In the proposed paper, A New Approach of Automobile Localization System Using GPS and GSM/GPRS Transmission, by Ioan Lita, Ion Bogdan Cioc, and Daniel Alexandru Visan started in 2006; the paper basically covers the whole concept of our research on monitoring vehicular activity. The same concept of tracking and monitoring the vehicle was merely developed for the reasons useful for adolescent drivers watching by their parents, in case of employees supervising, etc. The proposed application represents a low cost automotive localization system using GPS and GSM-SMS services for car localization. Optional, other parameters can be transmitted to inform the owner about car parameters like engine state, speed, speed limit exceeding or delimited area leaving, or giving car commands like engine stopping in theft situation, etc. This system can be connected to a PC or laptop for settings or for use as navigation system. Using the GPRS transmission, the presented system can realize car tracking function, together with automobile parameters and engine monitoring and alarm event signaling.

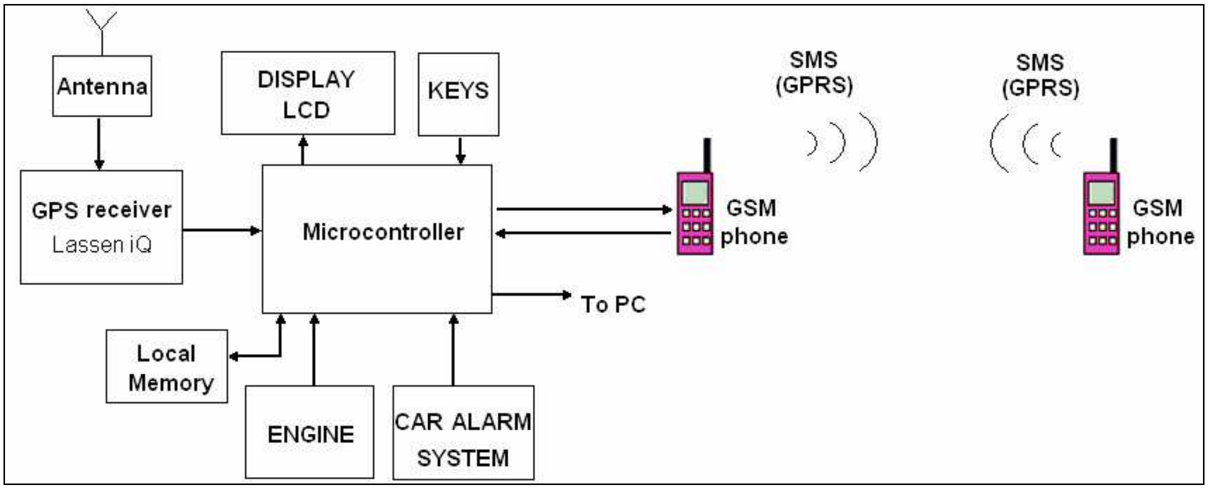

Figure 2.2 Block diagram of the complex automobile system with SMS / GPRS transmission

In this paper, the monitoring of the vehicle is an optional action in which every parameter of the vehicle is sent to the mobile of the owner of the car. This feature of the proposal is impractical since the storage of the cell phone isn't large enough to accommodate the data, and impractical since it will annoyingly keep alerting the owner of his car's activity, like when the engine starts, speed limit and area informative. This sort of application is only useful for car theft in which the request to monitor the car is only made possible when the owner is away from the vehicle and that the owner had activated the request for monitoring through the SMS feature. This serves as the alerting system, but the localization of where the car might have gone will be difficult to find, even with the use of the tracking system. As a recommendation from the paper, further development of complex car monitoring and control system is still being studied. No actual development of the hardware was made, but the concept of the

proposed system is shown in Figure1.1. The proposed solution can be used in other types of application, where the information needed is requested rarely and at irregular period of time.

Wireless Sensor Devices and Communication System

In the IEEE article, On the Architecture of Vehicle Tracking System Using Wireless Sensor Devices by Aravind .K. G, Tapas Chakravarty, M. Girish Chandra, and P. Balamuralidhar, the whole concept of tracking the vehicle down mainly focuses on the networking GPS of the vehicle itself through the use of low cost, effective implementation as in contrast to the existing high cost tracking systems. The whole idea of tracking the vehicle is based on Gateway nodes. These wireless nodes are addressed by the registration number of the vehicles which are unique. The GW nodes which are commonly known as road-side units (RSUs) are installed on the buildings, lamp posts etc. These nodes are connected to the underlying wired infrastructure (internet) to receive query from the central server and reply back with the necessary information. As the location of a vehicle to be tracked is unknown, broadcasting is chosen as mean of communication. This system too has many other applications like reporting accidents on the roads, so that nearest ambulance services may reach the spot thereby saving more lives.

Another article, Development of Tracking Train Detection Device (COMBAT)by Using Wireless Communication by Noriyuki Nishibori, and Tatsuya Sasaki, COMBAT stands for Computer and Microwave Balise Aided Train

detection. According to the article, The COMBAT comprises a microwave Balise (interrogator, wayside responder and on-board responder) and a processing unit. The interrogator and wayside responder are installed close to the entering signal and starting signal, holding the trackline in between. This system detects the existence and direction of the train at the detecting point (microwave Balise installation site).

The main problem of such application is that the information of tracking is being bounced from one GW node to another, this way of tracking a vehicle is very impractical due to many interferences that might occur on the location of the GW nodes. Another problem seen is that the location of the GW nodes itself which are mounted into posts and buildings, the location of these nodes is not that reliable because in due time these posts and building might no longer be able to support the nodes, and might as well distort the signal which can eventually occur into data loss. In the COMBAT application, though the tracking of the train is somewhat convenient, the problem seen here is that the train follows a provided route for them, thus the tracking of the train is irrelevant, and tracking system is no longer applicable here.

Vehicular Routing Problem

The Vehicle Routing Problem (VRP) can be described as the problem of designing optimal delivery or collection routes from one or several depots to a number of geographically scattered cities or customers, subject to side constraints. Vehicle Routing Problem or VRP is the fundamental problem in the

research fields of transportation; various types of VRP are studied to determine the optimal route under various constraints of locations, distance, time window and activities. In order to improve the route waste collection a certain type of algorithm is proposed. But it is difficult to straightly apply one case result to other cases, because the different constraints cause other difficult problems. Such problem occurrences in indeterminate since traffic in a location is unexpected, accidents happens sudden making is one factor for finding routes that makes a short route become a long way of travel. These factors are out of hand for the user of the vehicle so it shall be included in the limitation of the research. Versions of the problem and a wide variety of exact and approximate algorithms have been proposed for its solution. Exact algorithms can only solve relatively small problems, but a number of approximate algorithms have proved very satisfactory. However, several promising avenues of research deserve more attention, such as search methods.

Automatic Vehicle Location (AVL)

This Automatic Vehicle Location System (AVL) is a complete out-of-the-box low cost vehicle tracking solution: hardware, software and maps, ready to track. AVL is a combination of GPS and GIS with communications links added to track, locates, and log fleet vehicles. Customer service is improved by increased on-time deliveries, and faster response to customer pickup requests using AVL locate and send nearest vehicles functions. Track your fleet from your desktop with a low cost fully featured GIS-based map display and AVL system

that allows you to track your vehicle real-time on detailed street maps. Benefits of the AVL system that have been applied:

- Kansas City achieved reduced incident-response time, from 7-15 to 2-3 minutes, with use of AVL.
- Provides graphic or tabular report of vehicle activity (i.e., dwell time, speed).
- Sweetwater County, WY, almost doubled ridership without increasing dispatching staff by implementing AVL and CADS. Operating expenses decreased 50% per passenger mile.
- AVL and CADS allowed St. John's County Council on Aging in Augustine, FL, to reduce its scheduling, dispatching, and billing staff by half. Trips per vehicle hour have increased from 0.5 to 2.5.
- Collects driver log for use by payroll.
- Provides graphic or tabular report of vehicle activity (i.e., dwell time, speed).

DESIGN: Vehicle Accident SMS Alert with GPS Location Notification

In the design paper, Vehicle Accident SMS Alert with GPS Location Notification by Joshua Borja Cuesta, Maricar Ternida, Eugene Ancheta, Jessica Bernardino and Dexter Nidoy, the development of their design also mainly focuses on vehicular Accidents containing a SMS Module for the sending of

accident notification and a GPS Module that determines the location of the accident.

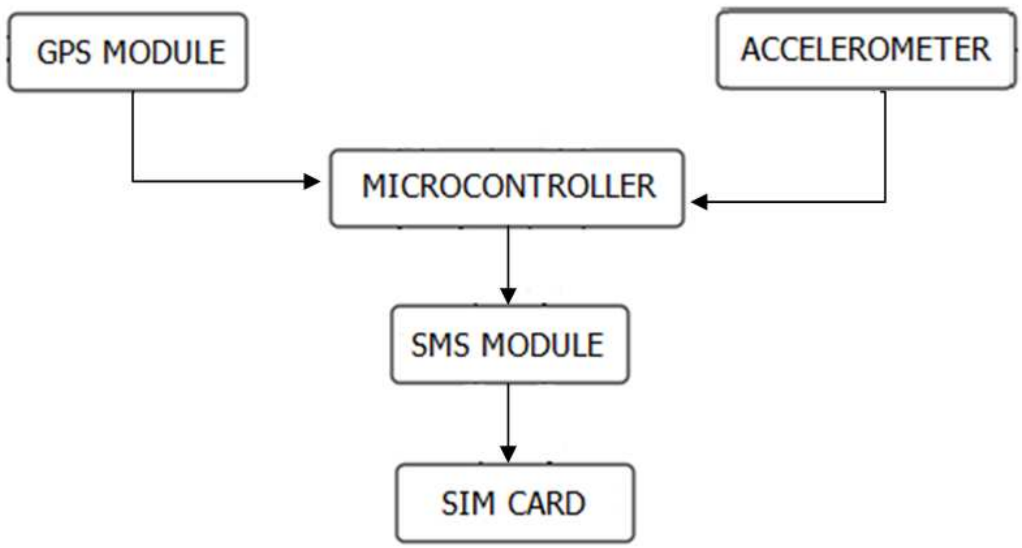

Figure 2.3 Block diagram of the Design Vehicle Accident SMS Alert with GPS Location Notification

Based from the given block diagram in Figure 2.3, the accelerometer serves as a sensor that shall be mounted on to the vehicle, this sensor shall detect inclination and movement of the vehicle. As programmed in the Microcontroller any strong impact or sudden brakes will trigger the an instruction to the microcontroller and immediately activating the SMS Module to send out the alert notification. The GPS module shall be responsible for the accident's location which will be also sent out. The SMS Module contains the SIM card fthat shall sent out the message, also taking note that it should have enough Load or balance to sent out the message.

Based from the design, the Accident alert notification system mainly bases its action on the accelerometer's angle of inclination and sensitivity. Using this related literature, the researchers used most of the concept of the design for the monitoring of Vehicular Parametric Measurements and location status. Using this design the researchers innovated and improved most of the feature as based from the recommendation given.

The difference of the two designs is that a Server and storage was added. A Server to monitor the vehicle from time to time and shall also act as a data storage for the LOCATION or ACCIDENT coordinates. While the VDIP Module was added for the USB Storage interfacing, the reason for the storage, as base from the recommendations found, is that their design needed storage for the sending of data. A SIM card is not enough to store the Vehicle's data location so a separate storage device was made. It is impractical since the storage of the cell phone isn't large enough to accommodate the data.

Chapter 3

DESIGN PROCEDURES

The group had used the related literature as cited in Chapter 2 about the whole idea of the design, with some major modification and altered improvements. This chapter gives a detailed discussion on how the step-by-step procedures will be used on the design in order to give the readers the idea on how the prototype has been created. This also helps the readers to easily understand on how the group contributed to be able to theorize the development of the design

Hardware Development

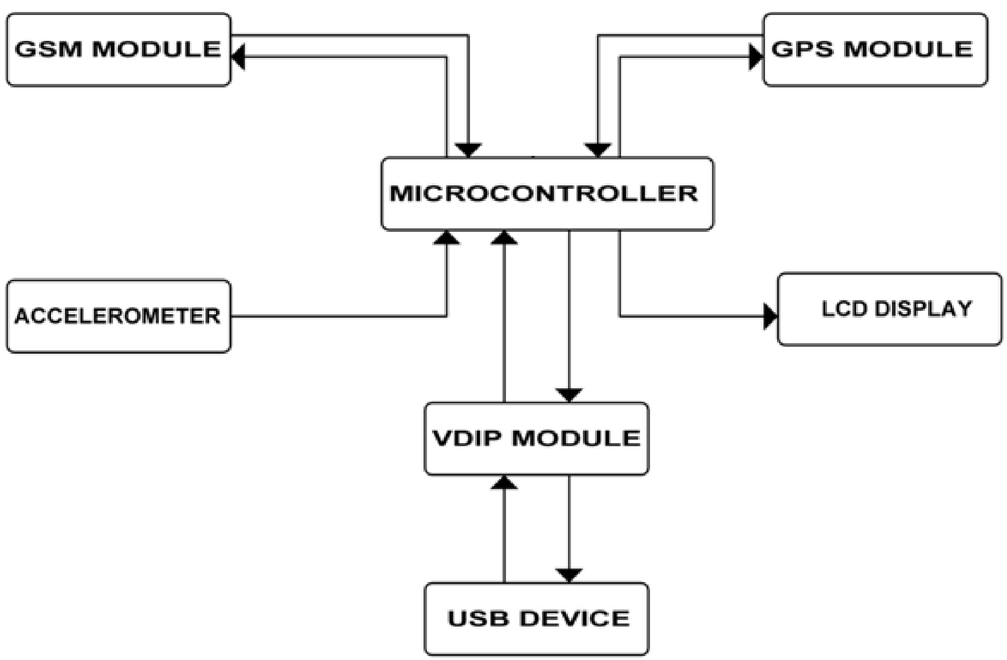

Figure 3.1

Block Diagram of Design

Figure 3.1 shows the block diagram which consists of the major parts of the device. This will help the readers to easily understand how the group came up with the design. It also shows the primary components of the device.

In developing the research, one must have full imagery on how the system is going to work. So the first step in doing the study is the development of the Block Diagram. In Figure 3.0, it can be seen that the whole system is dependent on the Microcontroller. The microcontroller shall serve as the main module of the design; it will control most of the device's functionality.

The GSM Module basically covers the whole concept of SMS alert. This module is only triggered when the accident occurs. This module is the ready solution for remote wireless applications, machine to machine or user to machine and remote data communications in all vertical market applications. GSM uses a process called circuit switching. This method of communication allows a path to be established between two devices. Once the two devices are connected, a constant stream of digital data is relayed. This allows the receiving end to hear the data being sent before the whole message or data were finished. The advantage to this is there's no wait time. In addition to the ignition control line, while the second strip contains all the communication signals and lines to and from the GSM module, as well as the analogical section of the phones

Next, the GPS module; this module composes of an antenna, that serves as the device's main feature for tracking. In this module, such unit must be used outdoors with a clear view of the sky, and are capable of locking into the signals

from the GPS satellites. The signals allow them to calculate the distances to these satellites, and with that data they can calculate position on the earth's surface in latitude and longitude within +/- 100 meters 95 % of the time. This module is also called the user segment because; this part consists of user receivers which are hand-held or, can be placed in a vehicle. All GPS receivers have an almanac programmed into their computer, which tells where each satellite is at any given moment. The GPS receivers detect, decode and process the signals received from the satellites. The receiver is usually used in conjunction with computer software to output the information to the user in the form of a map. As the user does not have to communicate with the satellite there can be unlimited users at one time.

The VDIP Module is used to provide a USB interface. Hence gives the ease of program development for interfacing while providing the convenience of USB support. This interface shall serve as a pathway of connection from the USB storage device to the tracking device itself. The USB device, often referred to as a jump drive, works like a plug-n-play device. Files can be transferred quickly form one work station to another, as well as to other portable devices like laptops.

The next module to deal with is the Accelerometer, in this module it shall take responsibility of detecting the vehicle's movement and inclination. An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. It is a certain type of sensor, which is sensitive to movement, for this study it is the vehicle's. By sensing the amount of dynamic acceleration, one can analyze the way the device is moving.

And lastly, the main processing unit of the whole tracking device is the Microcontroller, the functions of the this controls all the modules connected to it, the GSM, GSP, VDIP modules. The Microcontroller shall contain the instructions that shall be passed into each module upon operation of the device. This shall be programmed as to acquire the specific requirements of the design.

Schematic Diagrams

After studying the block diagram's main picture, next step is design the Tracking and Vehicular Monitoring device from the block diagram. In order for the device to become functional, or more importantly be built, one must first be familiar with the physical and complex structure of the vehicle into which the device shall be mounted. Once that had been studied thoroughly, next to build is the individual module of the device. The GPS, GSM, VDIP and Accelerometer Module are to be designed individually so as not to complicate the circuit. The Microcontroller shall be programmed as to incorporate these modules.

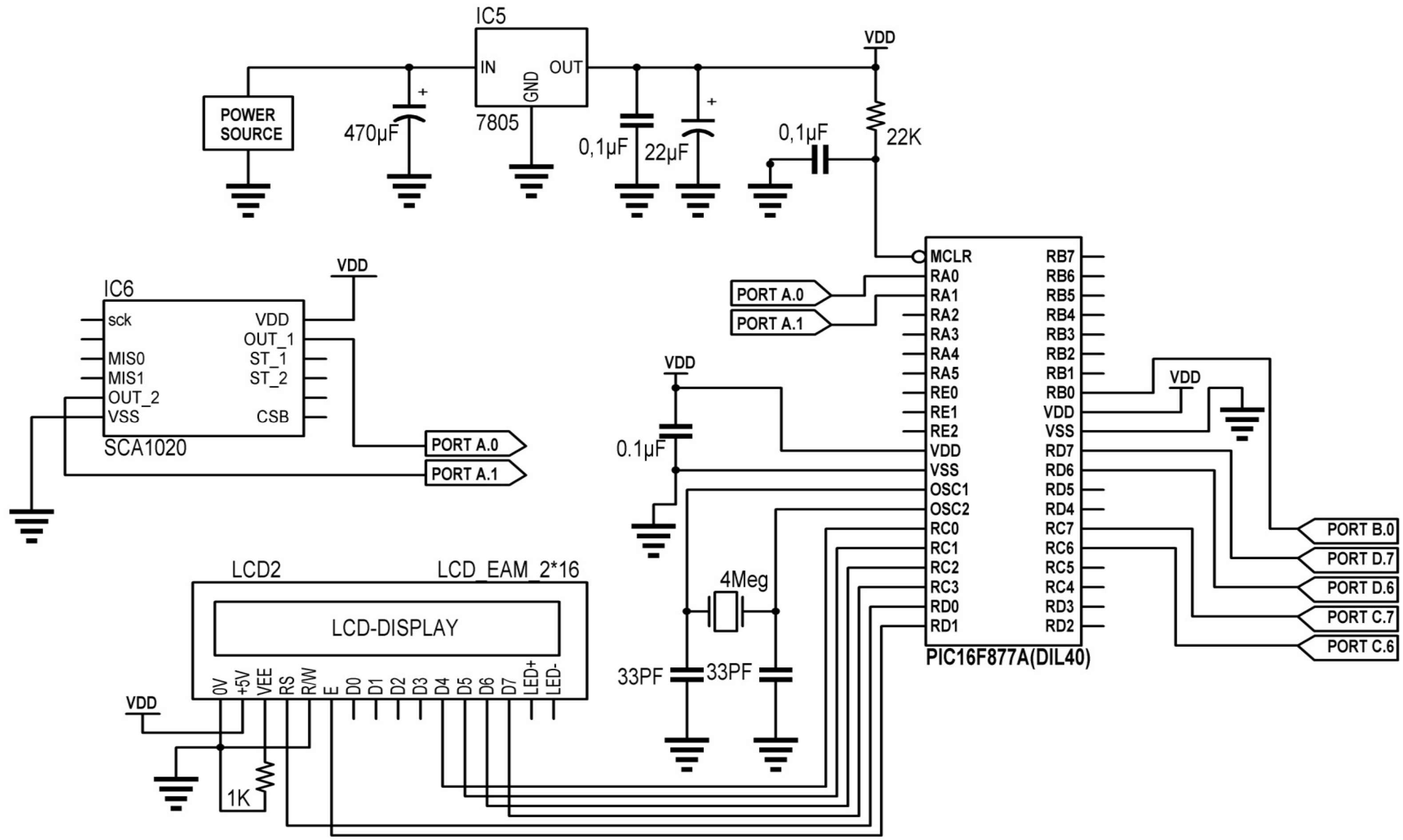

Figure 3.2

Schematic Diagram of Microcontroller

Figure 3.2 shows the Microcontroller's Module. In this module, the Microncontroller shall serve as the Brain of the device. The Microcontroller comprises of different instruction inputted anc coded into it. Most of the instrcutions involved are each of the other modules' operation. In the Figure 3.2, as shown in order to check whether all other modules are responding, a LCD was connected so as to monitor the device's initalization process. Based from the data sheet provided, the connection from the microcntroller to the LCD to the Pin labels RC1, RC2, RC3, RD1 and RD0 to the LCD's Pin labels D4, D5, D6, D7, E and RS respectiveley. This connection shall output the Initialization of each modules. Since the program has already been encoded, and the corresponding Message shall be outputted on LCD Screen. The LCD basically is used for checking the initialization of each module. It shall output if the initialization was successful or has failed. Another output message shall be shown when the car has been in an accident, since the device had been program to freeze when the accident occurs, the LCD shall display a Locked down Message saying Accident. After that the device had to be reset in order for it to work again.

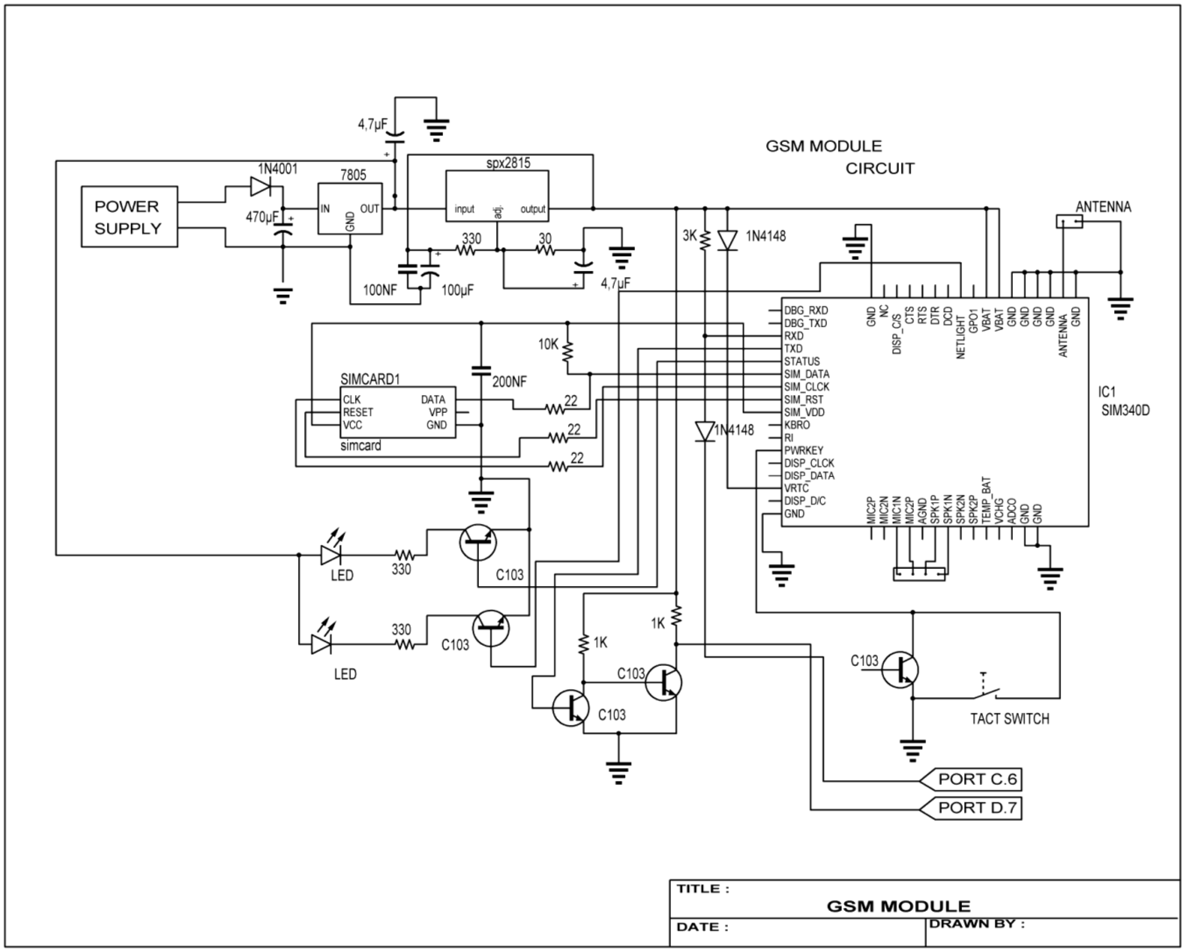

Figure 3.3

Schematic Diagram for GSM Module

The GSM module is resposible for the sending of message to the Server. The occurance of an accident or location updating shall be sent. As can be seen in the figure, the module uses GSM module and the IC SIM900D. On SIM900D, the SIM_DATA, SIM_CLK AND SIM_RST are directly connected to the SIM when it is properly placed on the module. Because of this, it allows the SIM card to access the GSM module. In the figure, the MIC1N, MIC2P, SPK1P AND SPK1N are also connected to it, so that the user can use the function call. The LED indicates

if the GSM module is power on and has a signal. As seen in Figure 3.3, the whole circuit basically acts like a cellphone but instead of the manual sending of the message, the microcontroller’s instruction shall command the GSM to keep sending messages every 3 seconds. And of course, along the circutry is the SIM card slot, a SIM card is needed in order to send the message provided that a SIM has enough load to send the messages. The SIM card Provider used for the circutry is Globe Telecoms, this provider was used because of its easy programmable receiver (Globe Tattoo).

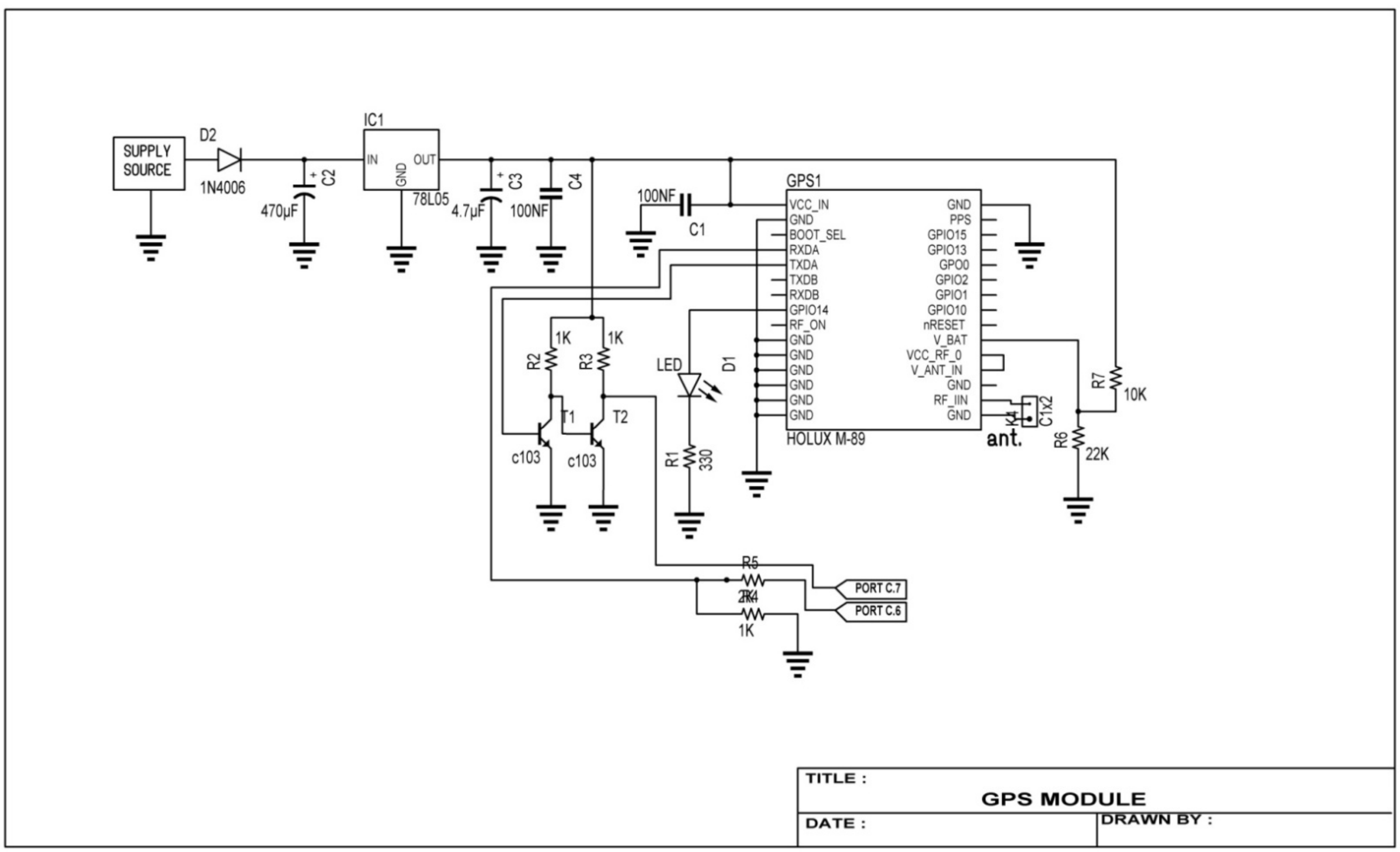

Figure 3.4

Schematic for GPS Module

The GPS module used was a GR-98, as stated early, it will be responsible for the vehicle's parametric location. In Figure3.4, it shows the whole circuit connection of the GPS alone, an antenna is connected on the circuit (RF-IN and GND) so as to receive the Signal. The LED shall serve as an indicator to determine if the GPS module is working. If the LED continuosly lights, it indicates that no signal is received but once the LED starts blinking, then the module had picked up a signal. The LED is connected, as based from the diagram, on the Pin Label GPIO14, this pin is used to detect the signal being transmitted into the module, once detected the component connected on it (for this circuit is the LED) shall output the corresponding action.

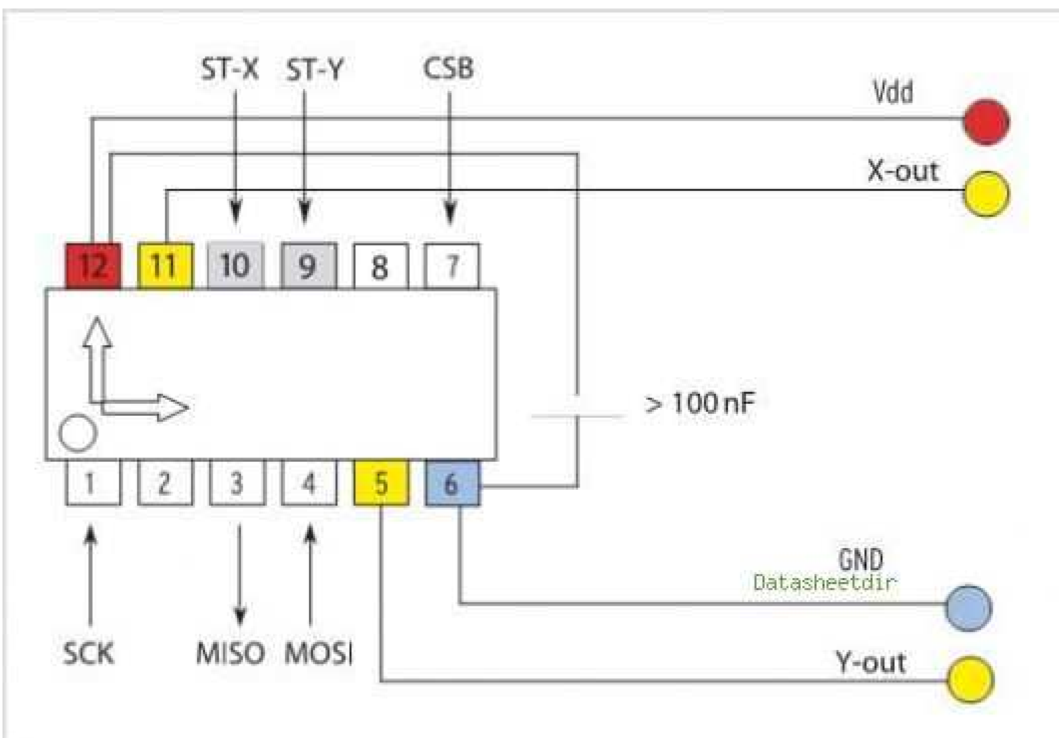

Figure 3.5

Schematic for Accelerometer

The type of Accelerometer used is a SCA1020, this accelerometer is sensitive to movement. Based on Figure 3.5, the arrow basically indicates the direction of the accelerometer. This is the based direction from which the device shall be dependent on. If ever the car had entered into an accident, the accelerometer's program direction of the arrow will be disaligned, thus triggering the GSM module that the acident has occured. ST-Y and ST-X are the self test pins so as to know the so called coordinates that serve as the accelerometers input for detecting movement. The MISO and MOSI serve as the the input-output of data.

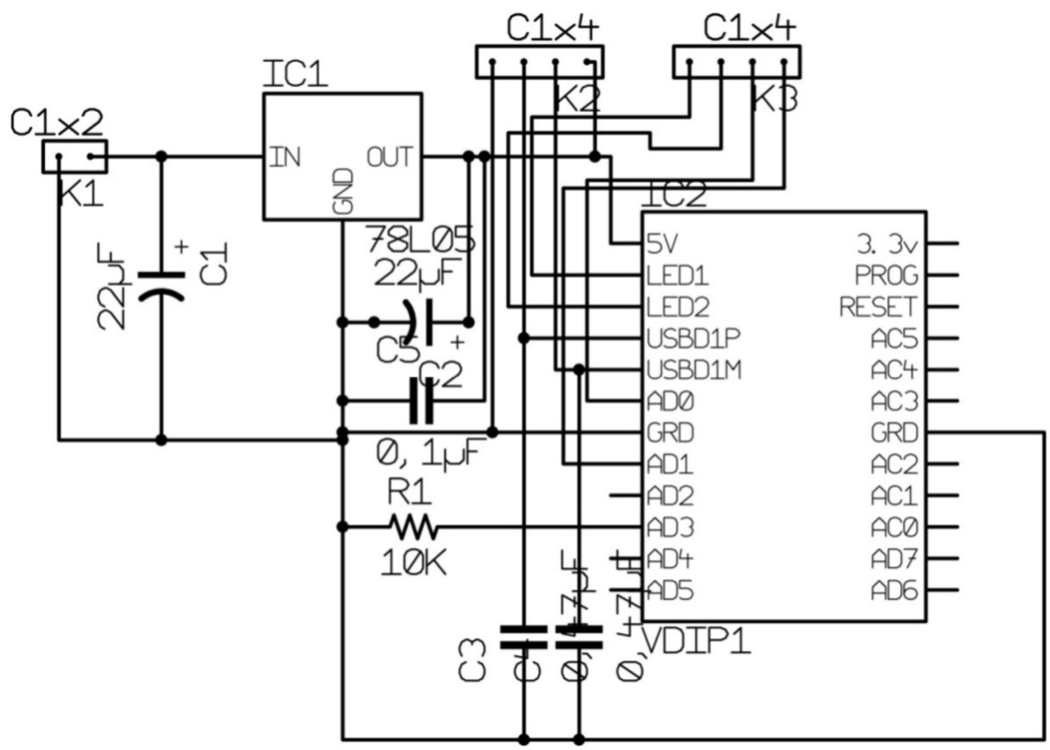

Figure 3.6

Schematic for VDIP Module

The VDIP module used for the design is a VDIP1 FTDI module. This module comes with a mounting interfaces so as to avoid the damaging of the pins. This module shall serve as the USB interface for which the recording of the Vehicle’s activities shall be generated on the USB. The microcontroller has been program to generate a LOG text file that shall record the Vehicle’s activities, the VDIP module’s role is to connect the USB device so as to allow data to be recorded into it.

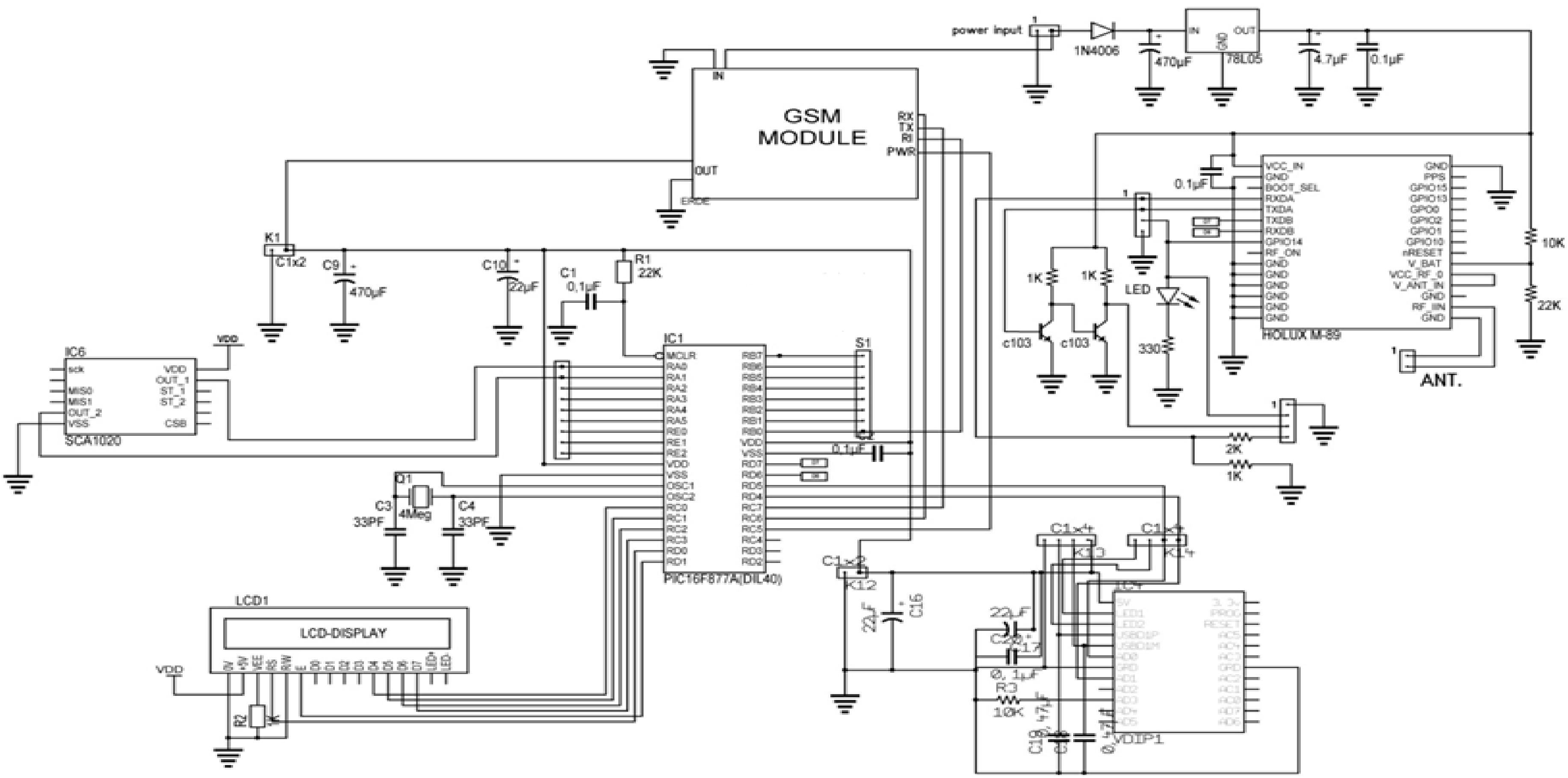

Figure 3.7

Schemati Diagram for the Combined Module for the Design

Figure 3.7 shows the overall connection of each module into the microcontroller. If one would observe, each module (VDIP, GPS, GSM) are independent to one another. So if one module is not responding the rest of the Modules will be left in a Hanging State, meaning all modules would not be responsive.

Software Developments

The microcontroller has the big part on the prototype because the entire program is saved on it. In this system development, the group shows the process on how the system works. First, he configures the devices like the USB, GSM and the GPS. When all initialization and configuration are done, he tests the whole system if it is working. The group tries to drive the toy car; if no accidents have taken place, reset the system. While if an accident happens the coordinates of the location and the time of the accident would be stored in the flash drive. If the system confirmed that an accident happened an SMS would be transmitted. If an SMS would be sent, the system would initialize the SMS to send a message to the subscriber indicating that an accident happened. Simultaneously the GPRS would also send the information needed by the subscriber.

Figure 3.8 shows the Program Flowchart. The Program flowchart is one of the tools that can help the readers to understand on how the design works. After the device has been turned on, initialization takes effect on the system.

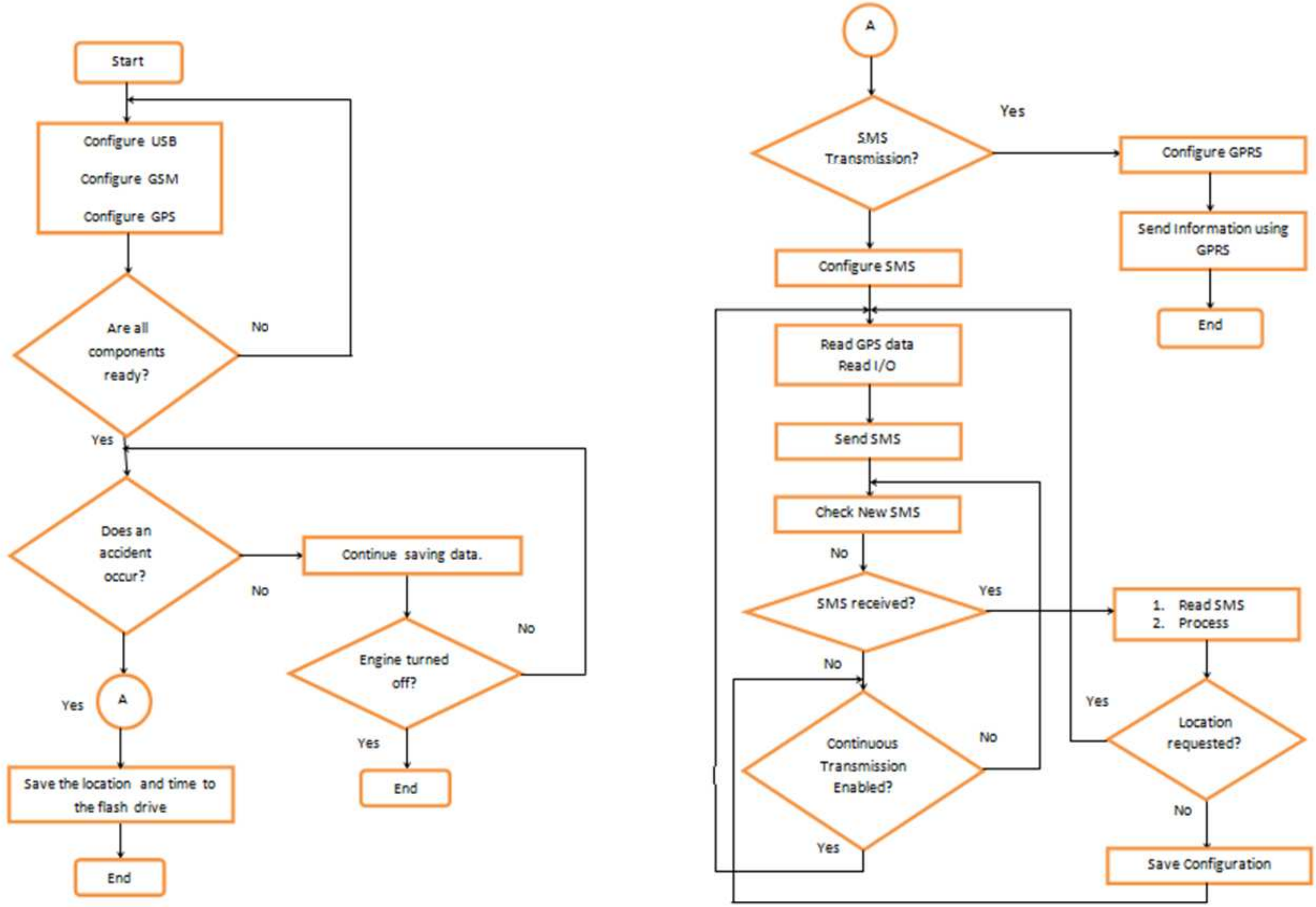

Figure 3.8 Program Flowchart

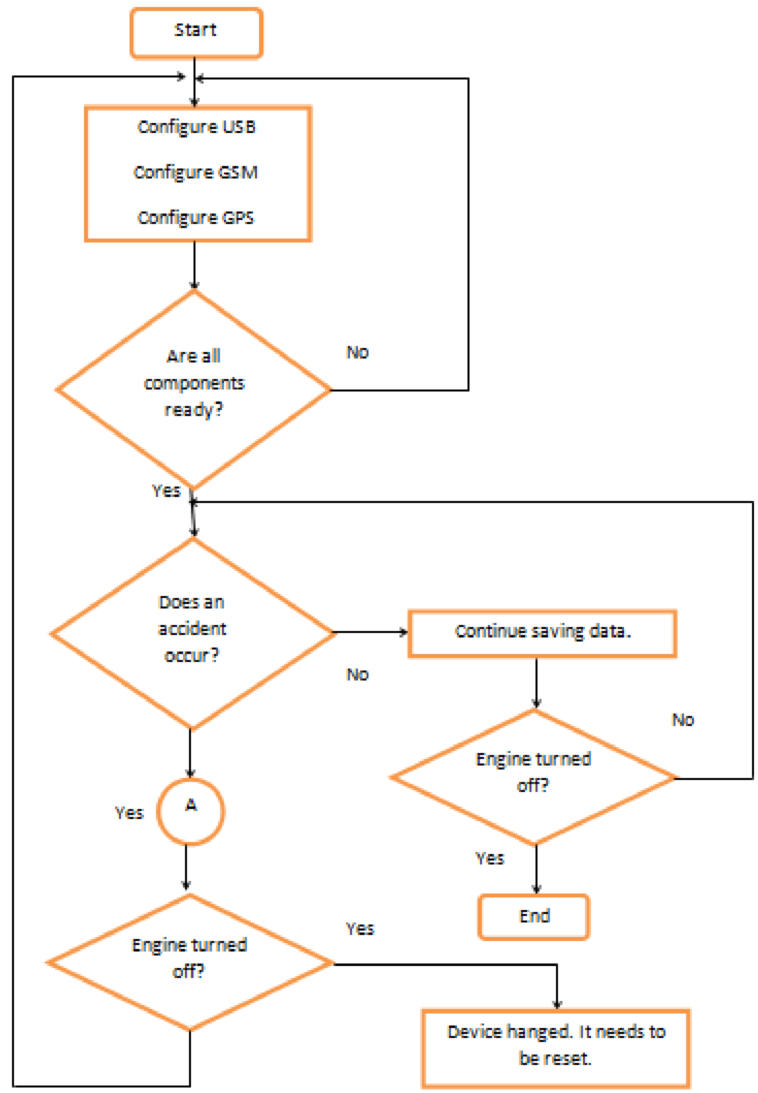

Figure 3.9 System Flowchart

Prototype Development

Once the discussion of the hardware and software development part was elaborated, the group came up with the groundwork of the materials and components in order to build the device along with the process on how to incorporate the materials and modules.

By showing all the materials and components that were used for the device in Table 3., the readers will understand how the group came up and built the desired design for the prototype.

Component w/ Specification	Quantity	Price per Unit	Total Amount
LCD (4x20)	1	P800.00	P800.00
GPS	1	P5,500.00	P5,500.00
GPS antenna	1	P2,500.00	P2,500.00
Capacitor (0.1	2	P4.00	P8.00
Capacitor 16V (470 microF)	1	P20.00	P20.00
Capacitor 35V (22 microF)	2	P20.00	P40.00
Capacitor 16V (33pF)	2	P1.50	P3.00

Capacitor 16V (10 microF)	1	P10.00	P10.00
Resistor ¼ W(22k)	2	P1.00	P2.00
MAX 232	1	P50.00	P50.00
IC Socket (16 pin)	2	P6.00	P12.00
IC Socket (40 pin)	1	P15.00	P15.00
Battery Holder	1	P10.50	P10.50
PIC16F877	1	P275.00	P275.00
Crystal Oscillator 3.92	1	P20.00	P20.00
8-pin Connection Male and Female	1	P25.00	P25.00
2-pin Connection Male and Female	2	P6.00	P12.00
Accelerometer	1	P2700.00	P2700.00
LED	1	P2.50	P2.50
Diode 4148	1	P1.50	P1.50
Alligator Clip	2	P5.00	P10.00
Battery 9V	1	P65.00	P65.00
Serial Connector	2	P25.00	P50.00

Battery Clip	1	P5.00	P5.00
SMS Module	1	P5,500.00	P5,500.00
LCD 2x16	1	P450.00	P450.00
DB SUB9	1	P19.00	P19.00
Casing	1	P50.00	P50.00
Switch On/off	1	P 20.00	P 20.00
VDIP Module	1	P 4000.00	P 4000.00

Table 3.1 List of Materials

1. An **accelerometer** is a device that measures the vibration, or acceleration of motion of a structure.

2. A **decoupling capacitor** is a capacitor used to decouple one part of an electrical network (circuit) from another.

3. The **Global Positioning System (GPS)** is a space-based global navigation satellite system(GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.

4. A **liquid crystal display (LCD)** is a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals (LCs).

5. **A microcontroller (PIC16F877A)** is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.

6. A **Regulator**, a device that maintains a designated characteristic

7. A **serial port** is a serial communication physical interface through which information transfers in or out one bit at a time.

8. A **Short Message Service (SMS)** is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices.

9. A **parallel port** is a type of interface found on computers for connecting various peripherals

10.A **USB (Universal Serial Bus)** is an industry standard developed in the mid-1990s that defines the cables, connectors and protocols used for connection, communication and power supply between computers and electronic devices.

11. A **voltage divider (also known as a potential divider)** is a simple linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in})

12. **PCB** also known as the printed circuit board, where the components are being attached to it.

CHAPTER 4

TESTING, PRESENTATION, AND INTERPRETATION OF DATA

Impact Analysis

By this innovation, the Company is able to secure their products/produces in terms of delivery services. When a company knows that their employees are trustworthy enough to do the job, they are much more secured in letting them handle their product/produce. And also the company is able to monitor their employees' activity even when they are on the road. This innovated tracking device system also helps solve the cause of common car accidents by letting one know exactly what happened before and after the accident occurs. Another benefit is the updating of information. Sometimes in isolated area where accidents sometimes happen, help response come in late to save a life, by this design, the researchers used the GPS and SMS technology to be triggered once the accident happened and to send the information immediately to the server to alert that help is needed.

GPS Testing

The purpose of this test is to determine if the GPS unit will be able to initialize without difficulty in getting signal. Another test should be made with the use of the design itself- a blinking LED will serve as an indicator of the status of the GPS, an LCD that will display a value of 1 or 0 that serves as the representation of the status of the GPS and will display the coordinates taken. If the GPS status is equivalent to 1, this indicates that the GPS is ready for testing

and a status of 0 means that the GPS is still initializing. Before conducting the tests, the program for the GPS should be run and would be taken from the Google Maps in the internet. The coordinates will be given in North-East format and the location will be pointed in the site. Mapua Institute of Technology is the location used for testing of the device. The table (Table 4.1) below shall be used to conduct the summarization of the results.

Trial	**Weather Condition**	**Type of Device Location**	**GPS Initializing Time**	**LCD Display**
Trial 1	Heavy rains	Closed Area	Did not initialize	GPS = 0
Trial 2	Heavy rains	Open Area	5 mins	N,14.5902 E,120.9768
Trial 3	Sunny	Closed Area	1.8 mins	N,14.5902 E,120.9773
Trial 4	Sunny	Open Area	1 min.	N,14.5904 E,120.9771
Trial 5	Cloudy	Open Area	1.20 mins	N,14.5902 E,120.9768
Trial 6	Cloudy	Open Area	1.10 mins	N,14.5904 E,120.9775
Trial 7	Cloudy	Open Area	1 min.	N,14.5884 E,120.9798
Trial 8	Cloudy	Open Area	1.50 mins.	N,14.5892 E,120.9790
Trial 9	Cloudy	Open Area	1.50 mins.	N,14.5899 E,120.9783
Trial 10	Cloudy	Open Area	1.45 mins.	N,14.5905 E,120.9777
Trial 11	Cloudy	Open Area	1min	N,14.5905 E,120.9778
Trial 12	Sunny	Open Area	0.50 mins.	N,14.5905 E,120.9778
Trial 13	Sunny	Open Area	0.45 mins.	N,14.5908 E,120.9777

Trial 14	Sunny	Open Area	1 min.	N,14.5908 E,120.9777
Trial 15	Sunny	Open Area	0.48 mins.	N,14.5908 E,120.9777
Trial 16	Sunny	Closed Area	1.7 mins	N,14.5908 E,120.9779
Trial 17	Sunny	Closed Area	1.8mins	N,14.5910 E,120.9776
Trial 18	Sunny	Closed Area	1.50 mins	N,14.5904 E,120.9782
Trial 19	Sunny	Closed Area	1.50 mins.	N,14.5903 E,120.9782
Trial 20	Sunny	Closed Area	1.8mins	N,14.5906 E,120.9781
Trial 21	Sunny	Closed Area	1.8mins	N,14.5908 E,120.9780
Trial 22	Cloudy	Closed Area	2 mins.	N,14.5902 E,120.9768
Trial 23	Cloudy	Closed Area	2 mins.	N,14.5899 E,120.9789
Trial 24	Cloudy	Closed Area	2 mins.	N,14.5904 E,120.9779
Trial 25	Heavy rains	Open Area	3.45 mins.	N,14.5914 E,120.9777
Trial 26	Heavy rains	Open Area	4.5 mins.	N,14.5912 E,120.9780
Trial 27	Heavy rains	Closed Area	Did not initialize	GPS = 0
Trial 28	Heavy rains	Closed Area	Did not initialize	GPS = 0
Trial 29	Heavy rains	Closed Area	Did not initialize	GPS = 0
Trial 30	Heavy rains	Closed Area	Did not initialize	GPS = 0

Table 4.1 Testing for the operation of the Global Positioning System (GPS)

Based on the results, the initialization of the GPS depends on the signal gathered by the antenna. Weather condition and type of location may affect its initialization. The table shows that if the weather is good and operated in an

open area, the GPS module will initialize at an estimated time of 1 minute while in a closed area, a small discrepancy on initializing time is observed. Also, if the weather condition is rainy and tested on a closed area, the device will not initialize because of some difficulties in gathering signals.

VDIP Module Testing

The role of the VDIP module is to record and store the data on the server and on the USB device. In order to check whether data had been recorded, series of activities that the vehicle would do (example: start engine, break, speed up, etc.) shall be conducted. After the testing, the data shall be compared with the number of activities done by the vehicle with the number of activities recorded into the USB device. This comparison test shall check whether the Microcontroller had been programmed as to the expected outcome.

Trials	Device	Location	Remarks
Trial 1	Vehicle	N,14.5902 E,120.9768	Same data
	USB Device	N,14.5902 E,120.9768	
Trial 2	Vehicle	N,14.5902 E,120.9773	Same data
	USB Device	N,14.5902 E,120.9773	
Trial 3	Vehicle	N,14.5904 E,120.9771	Same data
	USB Device	N,14.5904 E,120.9771	

Trial 4	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 5	Vehicle	N,14.5884 E,120.9798	Same data
	USB Device	N,14.5884 E,120.9798	
Trial 6	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 7	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 8	Vehicle	N,14.5904 E,120.9771	Same data
	USB Device	N,14.5904 E,120.9771	
Trial 9	Vehicle	N,14.5901 E,120.9773	Same data
	USB Device	N,14.5901 E,120.9773	
Trial 10	Vehicle	N,14.5902 E,120.9772	Same data
	USB Device	N,14.5902 E,120.9772	
Trial 11	Vehicle	N,14.5903 E,120.9771	Same data
	USB Device	N,14.5903 E,120.9771	
Trial 12	Vehicle	N,14.5904 E,120.9772	Same data
	USB Device	N,14.5904 E,120.9772	
Trial 13	Vehicle	N,14.5903 E,120.9772	Same data
	USB Device	N,14.5903 E,120.9772	
Trial 14	Vehicle	N,14.5902 E,120.9773	Same data

	USB Device	N,14.5902 E,120.9773	
Trial 15	Vehicle	N,14.5902 E,120.9768	Same data
	USB Device	N,14.5902 E,120.9768	
Trial 16	Vehicle	N,14.5904 E,120.9783	Same data
	USB Device	N,14.5904 E,120.9783	
Trial 17	Vehicle	N,14.5905 E,120.9782	Same data
	USB Device	N,14.5905 E,120.9782	
Trial 18	Vehicle	N,14.5906 E,120.9779	Same data
	USB Device	N,14.5906 E,120.9779	
Trial 19	Vehicle	N,14.5907 E,120.9775	Same data
	USB Device	N,14.5907 E,120.9775	
Trial 20	Vehicle	N,14.5906 E,120.9781	Same data
	USB Device	N,14.5906 E,120.9781	
Trial 21	Vehicle	N,14.5903 E,120.9776	Same data
	USB Device	N,14.5903 E,120.9776	
Trial 22	Vehicle	N,14.5904 E,120.9777	Same data
	USB Device	N,14.5904 E,120.9777	
Trial 23	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	
Trial 24	Vehicle	N,14.5904 E,120.9777	Same data
	USB Device	N,14.5904 E,120.9777	

Trial 25	Vehicle	N,14.5900 E,120.9778	Same data
	USB Device	N,14.5900 E,120.9778	
Trial 26	Vehicle	N,14.5905 E,120.9776	Same data
	USB Device	N,14.5905 E,120.9776	
Trial 27	Vehicle	N,14.5900 E,120.9778	Same data
	USB Device	N,14.5900 E,120.9778	
Trial 28	Vehicle	N,14.5900 E,120.9778	Same data
	USB Device	N,14.5900 E,120.9778	
Trial 29	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	
Trial 30	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	

Table 4.2 VDIP Module Testing

The test for the VDIP module is simply checking if the activities recorded by the vehicle are equal with the data stored in the USB device. The table shows that the activities of the vehicle are equal to the activities stored on the USB device.

GSM Module Testing

The SMS testing shall be made on the GSM module, since one of the objectives of the design is to provide accurate and early information if an accident had occurred. This module is used to check whether the receiver had received the default SMS, once the accident had occurred. The data shall be

expected with no precise result since the sending and receiving of the message is entirely dependent on the service provider and the signal. The testing is simple, just trigger the GSM Module as if an accident had occurred then test whether the message had been received or not. This sort of testing shall check the functionality of the GSM Module. In order to check this, the Server shall be used. The Server is responsible for monitoring of the GPS and GSM Module. The table (Table 4.3) shall be used to record the results.

Trial	Sending (Sent/Fail)	Receiving (Received/Failed/Delayed)
Trial 1	Sent	Received
Trail 2	Sent	Received
Trial 3	Sent	Received
Trial 4	Sent	Received
Trial 5	Sent	Received
Trial 6	Failed	Failed
Trial 7	Failed	Failed
Trial 8	Failed	Failed
Trial 9	Sent	Delayed
Trial 10	Sent	Delayed
Trial 11	Sent	Delayed
Trial 12	Sent	Delayed

Trial 13	Sent	Delayed
Trial 14	Sent	Delayed
Trial 15	Sent	Delayed
Trial 16	Sent	Received
Trial 17	Sent	Received
Trial 18	Sent	Received
Trial 19	Sent	Received
Trial 20	Sent	Received
Trial 21	Sent	Received
Trial 22	Sent	Received
Trial 23	Sent	Received
Trial 24	Sent	Received
Trial 25	Sent	Received
Trial 26	Sent	Received
Trial 27	Sent	Received
Trial 28	Sent	Received
Trial 29	Sent	Received
Trial 30	Sent	Received

Table 4.3 GSM Module Testing

Based on the results, the data or messages that were sent were received on time because of the high signal. Some messages that were sent were delayed because of the low signal and some problems from the service provider. Also,

the sim card used should have an amount of load that can support its texting or transferring of data or else it will fail.

Accelerometer Testing

The accelerometer's sensitivity is triggered by the movement of the vehicle, it shall be noted on what position the accelerometer will detect the vehicle's movement and quickly transfer the data for recording. The accelerometer shall run series of trials to see how fast it can detect sudden change of movement. The Table 4.4 shall be used for the testing of the module.

Trial	Accelerometer Reading		Remarks
	X-coordinates	Y-coordinates	
Trial 1	+1 g position	0 g position	No accident occurred
Trial 2	-1 g position	0 g position	Accident occurred
Trial 3	0 g position	+1 g position	Accident occurred
Trial 4	0 g position	-1 g position	Accident occurred
Trial 5	0 g position	+1 g position	Accident occurred
Trial 6	0 g position	+1 g position	Accident occurred
Trial 7	0 g position	+1 g position	Accident occurred
Trial 8	+1 g position	0 g position	No accident occurred
Trial 9	+1 g position	0 g position	No accident occurred
Trial 10	-1 g position	0 g position	Accident occurred
Trial 11	0 g position	+1 g position	Accident occurred
Trial 12	+1 g position	0 g position	No accident occurred
Trial 13	+1 g position	0 g position	No accident occurred

Trial 14	-1 g position	0 g position	Accident occurred
Trial 15	-1 g position	0 g position	Accident occurred
Trial 16	+1 g position	0 g position	No accident occurred
Trial 17	-1 g position	0 g position	Accident occurred
Trial 18	0 g position	+1 g position	Accident occurred
Trial 19	+1 g position	0 g position	No accident occurred
Trial 20	+1 g position	0 g position	No accident occurred
Trial 21	-1 g position	0 g position	Accident occurred
Trial 22	0 g position	+1 g position	Accident occurred
Trial 23	+1 g position	0 g position	No accident occurred
Trial 24	+1 g position	0 g position	No accident occurred
Trial 25	-1 g position	0 g position	Accident occurred
Trial 26	0 g position	+1 g position	Accident occurred
Trial 27	+1 g position	0 g position	No accident occurred
Trial 28	+1 g position	0 g position	No accident occurred
Trial 29	+1 g position	0 g position	No accident occurred
Trial 30	+1 g position	0 g position	No accident occurred

Table 4.4 Accelerometer Testing

Table 4.4 shows the different position of the accelerometer that can be seen on its datasheet. The result shown above determines when an accident may occur according to the position of the accelerometer in X – Y format.

Chapter 5

CONCLUSION AND RECOMMENDATION

Conclusion

Global positioning system is a global satellite navigational system, which enables tracking down the location and many other important details of assets like vehicles, cargo containers, etc. At present, besides tracking down the vehicle's location, the technology is used for performing hosts of military applications, medical applications, etc.

The development of the design was made so as to ensure that a company will be able to monitor their vehicle so as to determine whether it has been utilized properly and had not undergone illegal transaction that is unknown to the company. The design was also developed in order to decrease the rising number of road accidents that occur. More than 10% of the world's population dies of road accident each year.

Recording the activities that the vehicle had made the whole day makes it easier to analyze and determine data. Using the collected data can help minimize false guessing of where the vehicle might have gone. The data are very crucial part of monitoring the device. Without such data, the driver can easily declare that he had done his job right, or declare that the car was under the company business transaction, in which may turn out to be lie.

A final conclusion to state is that GPS vehicular tracking system is a very effective technology that has made possible to perform the business operations

with complete security. Monitoring the vehicle makes the user or individual become fully aware of his time managerial on the road, the daily routes he should take for better.

Knowing the places on which the vehicle has gone makes it easier to know whether the vehicle has any business on that area. Whether it is legal or not, the location is a huge factor in monitoring the vehicle's activities.

Recommendation

This design can be improved for further studies. For one, the design was specifically made for everyday used cars and vehicles. The design can be further enhanced so as to accommodate manual and automatic cars.

The design was made as whole component, meaning that each module was designed so as to be dependent on the other modules. When one module fails to initialize properly (more commonly the GPS Module due to signal problems) the other modules hang or no longer responding. The design could use some improvements on the module independency.

Another improvement that can be made is creating a reset button in case the device has not responded or has already undergone a lock down when the accident occurs.

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APPENDIX

A. Operation's Manual

1. System Requirement

The "DESIGN OF THE GPS TRACKING SYSTEM FOR MONITORING VEHICULAR ACTIVITIES WITH ACCIDENT NOTIFICATION VIA SMS" only works if we toggle the switch on. The required battery is a 10 Volts RC car battery. A SIM card of any network is also a requirement for the design for the GSM module to function properly. A Flash drive is needed to save data once the device is turned – on. A good signal is needed for the GPS to work.

2. Installation Procedures

The following procedures must be followed carefully to ensure the optimal performance of the accident alert system!

Inserting SIM card:

1. For the SIM card, store the numbers needed to be alerted or informed when an accident occurs. Always have an assurance that the SIM has sufficient load or credits to send messages.
2. Insert the SIM card in the slot in the device and secure the casing carefully.
3. Place the device on a stable spot over the device or dashboard. Be sure to fasten it well to keep it secure. The location should be kept steady and safe to minimize false alarms!

Inserting Flash drive:

1. Simply locate the VDIP Module interface and mount the USB Flash Drive.
2. Check if Green Light is blinking.

Charging of Device:

1. Turned-off the toggle switch of the device. The LED on the device should not be lit-up. It indicates whether the components have power or not.
2. Plug it on the car battery outlet. This will keep the device powered-on while travelling or when the car engine is turned on.

Switching the device on or off:

1. Toggle the switch on. Notice that the LED of the device is now lit-up.
2. Wait for the LED to blink. This indicates that the GPS receiver, USB, and GSM module are already connected with the GPS satellites and the device is ready for use.
3. When the LED does not blink for a period of time, press reset button. Check the location of the device. Again, wait for the LED to blink.
4. Just leave the toggle switch of the device on and it will function by itself.

5. To turn off the device, just toggle the switch off.

3. User's Manual

3.1. Turn On the Car

3.2. Check that the device is initializing on the LCD Screen.

3.3. Ensure Car is in an open area for better GPS initialization.

3.4. Ensure SIM card is inserted.

3.5. Ensure USB Flash Drive had been mounted on the VDIP Module

3.6. Once initialization is complete, the device is ready for tracking and monitoring the Car.

3.7. If false alarms happened, press the reset button while the device is beeping to cancel the sending of messages.

3.8. When an accident occurs, the device will be hanged until the reset button is pressed.

3.9. When an accident occurs, an SMS message will be sent through GSM module to the mobile numbers saved in the SIM card. This will inform the person that an accident has occurred and will provide the location where it has happened. Furthermore, before and after the accident, data are saved in the memory.

4. Troubleshooting Guides and Procedures

4.1. When the LCD Screen displays VDIP Module Failed to initialize, Check and secure that the VDIP device is mounted properly. Check if the Green Light is blinking, this indicates that the VDIP module is properly mounted.

Once checked, turn off the device and wait for 5 seconds and then on the device again.

4.2. When the LCD Screen displays GSM Module Failed to initialize, check if SIM card is available or locked in place on the SIM holder slot. Check if the LED lights are blinking every 3 second, if not reset the device and wait for 5seconds before turning it back on.

4.3. When the LCD Screen displays GPS Module Failed to initialize, simply reposition the Antenna. If possible bring the device in an open area so as to pick up a signal quickly. If initialization fails again, turn off the device and turn it on after 5 seconds.

4.4. When the LCD Screen shows that the GPS Module is still under initialization process, this means that no signal is being detected. Turn off the device, reposition the antenna for better signal detection and turn on the device again. Check the LED, if the LED is in continuously lighting it means no signal was found, but when it starts to blink the GPS had detected a signal.

4.5. For the Server's Google capabilities, make sure internet access is available. If the display on the server shows the Message : The Web is Not Available, simply press F5 on your keyboard. If the message still continuous to display the same message, exit the program and restart it again.

5. Error Definition

5.1. GPS module's LED is lit – no signal is being detected.

5.2. GSM module's LED is lit – no signal is being detected.

5.3. VDIP module's LED has no green light – Its not being detected by the device.

5.4. LCD displays "Initializing" – The device is still initializing.

5.5. LCD displays "System lockdown" – Accident has been detected by the device. Needs to be shut down and initialized again to make the device work.

B. Picture of Prototype

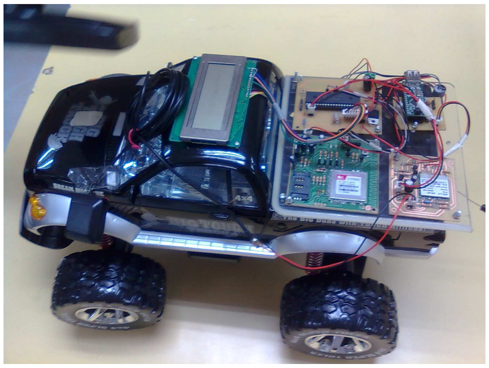


Figure A.1

Figure A.2

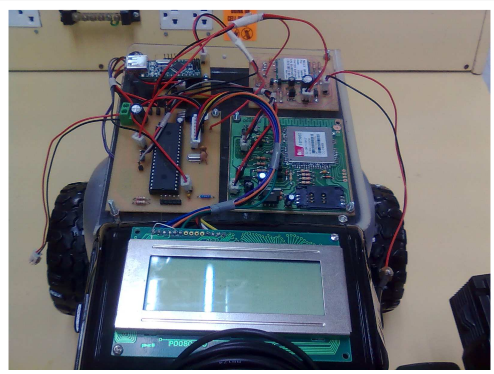
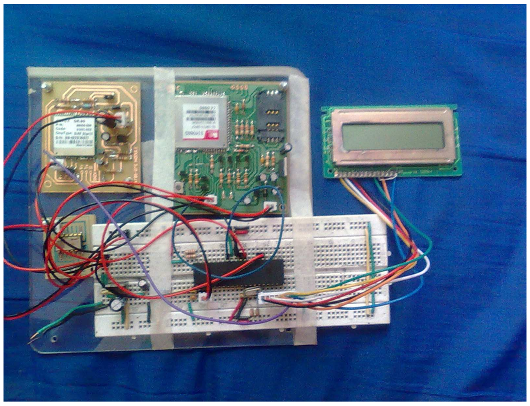


Figure A.3

Figure A.4



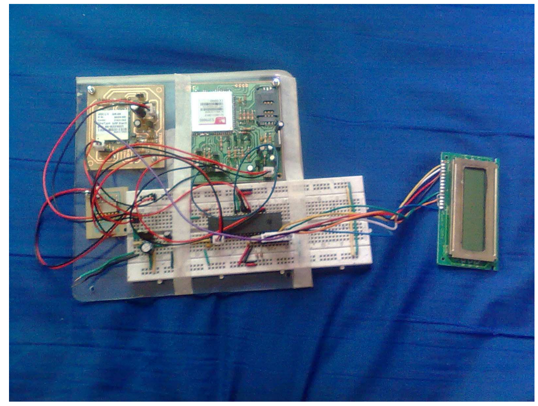
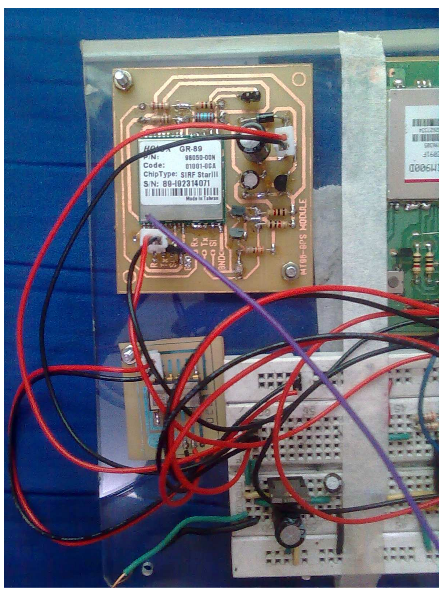


Figure A.5

Figure A.6



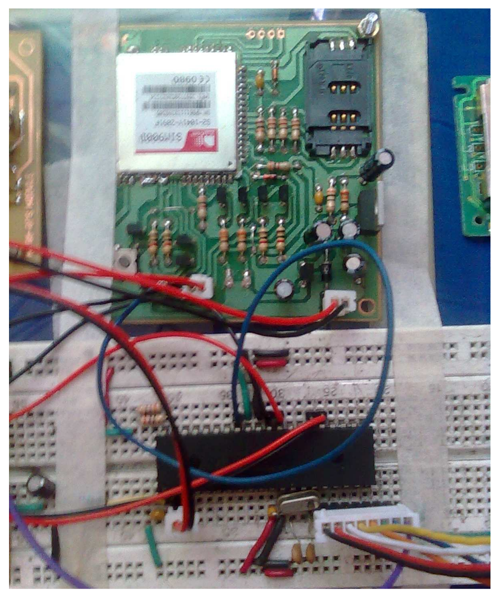
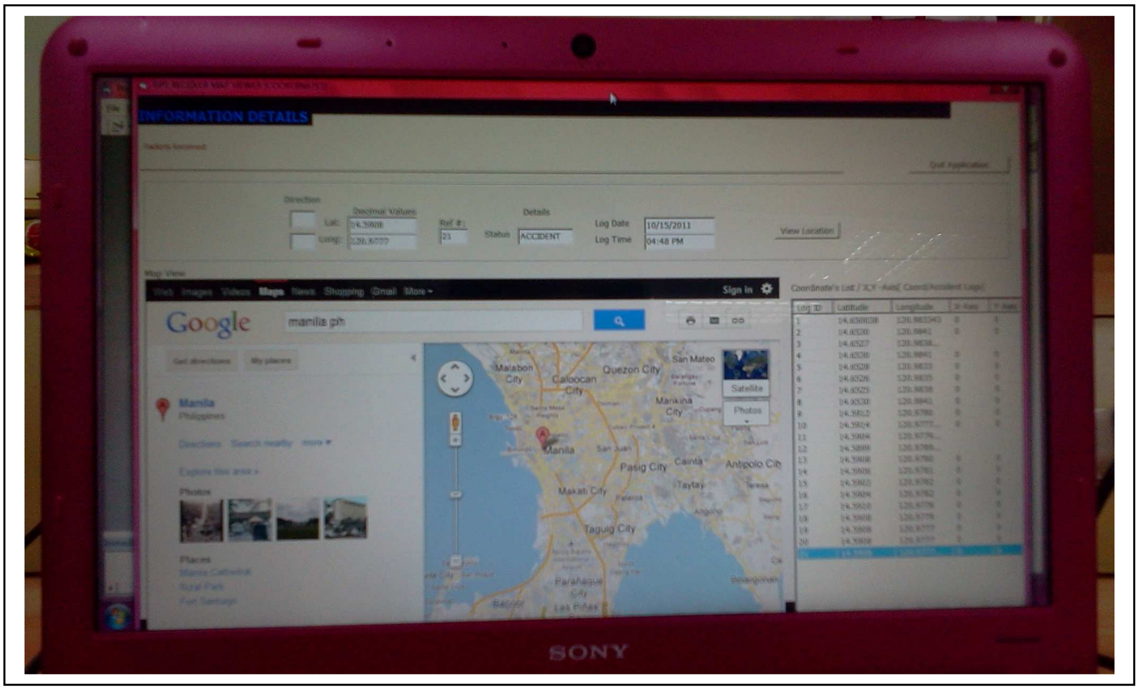


Figure A.7

Figure A.8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Google
manila ph
Quezon City
Manila
Pasig City
Makati City
Taguig City
SONY

Figure A.9

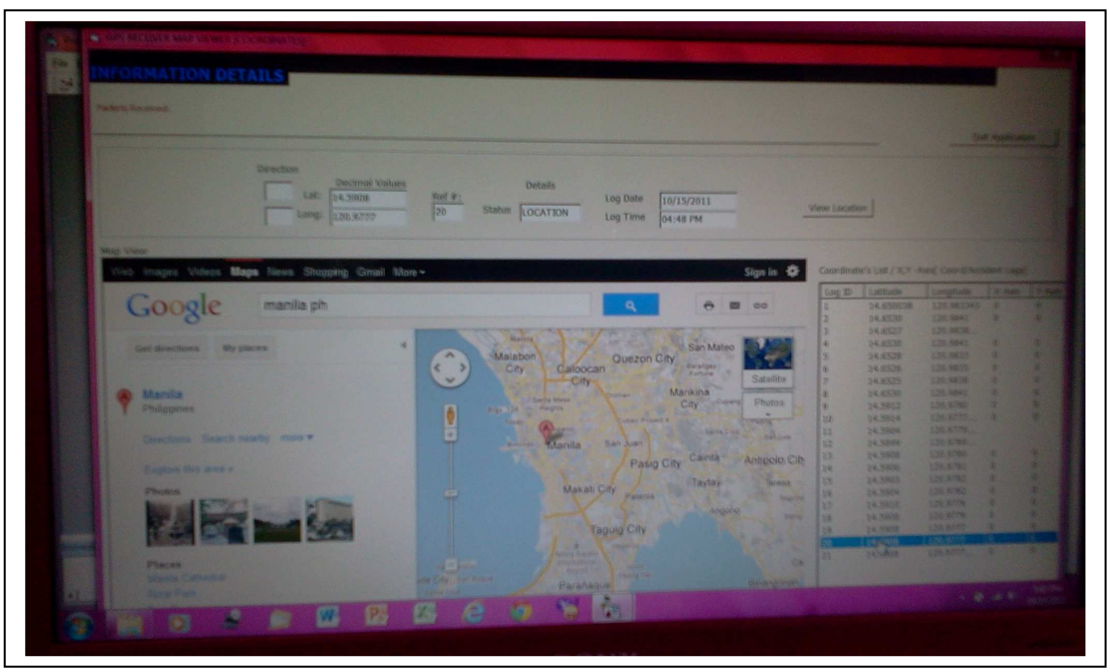
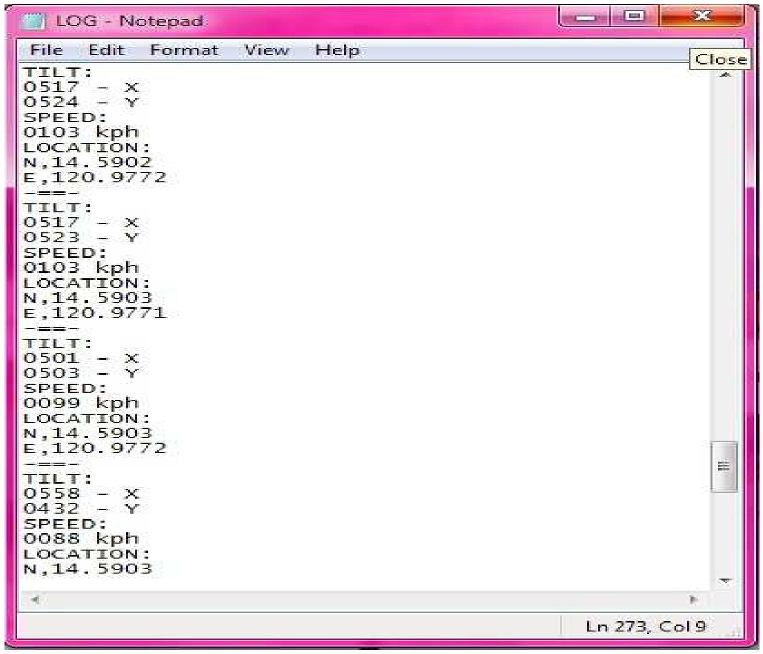

INFORMATION DETAILS
Google
manila ph
Quezon City
Manila
Pasig City
Makati City
Taguig City

Figure A.10



LOG - Notepad

File Edit Format View Help

```
TILT:
0517 - X
0524 - Y
SPEED:
0103 kph
LOCATION:
N,14.5902
E,120.9772
-==-
TILT:
0517 - X
0523 - Y
SPEED:
0103 kph
LOCATION:
N,14.5903
E,120.9771
-==-
TILT:
0501 - X
0503 - Y
SPEED:
0099 kph
LOCATION:
N,14.5903
E,120.9772
-==-
TILT:
0558 - X
0432 - Y
SPEED:
0088 kph
LOCATION:
N,14.5903
```

Ln 273, Col 9

Figure A.11

Figure A.12

C. Data Sheets

PIC16F874A/877A

40-Pin Enhanced FLASH Microcontroller Product Brief

High Performance RISC CPU:

- Only 35 single word instructions to learn
- All single cycle instructions except for program branches, which are two cycle
- Operating speed: DC - 20 MHz clock input
  DC - 200 ns instruction cycle
- Up to 8K x 14 words of FLASH Program Memory,
  Up to 368 x 8 bytes of Data Memory (RAM),
  Up to 256 x 8 bytes of EEPROM data memory
- Pinout compatible to other 40-pin PIC16CXXX and PIC16FXXX microcontrollers

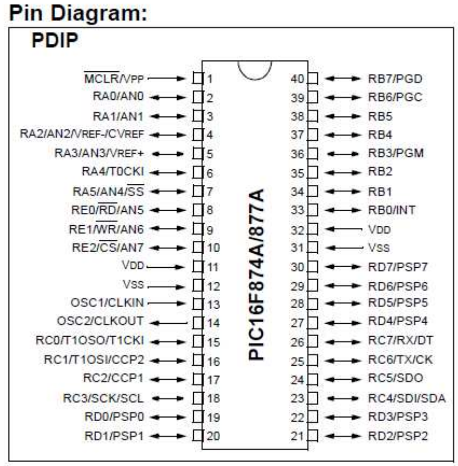
Peripheral Features:

- Timer0 module: 8-bit timer/counter with 8-bit prescaler
- Timer1 module: 16-bit timer/counter with prescaler, can be incremented during SLEEP via external crystal/clock
- Timer2 module: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
- Master Synchronous Serial Port (MSSP) module. Two modes of operation:
  - 3-wire SPI™ (supports all 4 SPI modes)
  - I^2C™ Master and Slave mode
- Addressable USART module:
  - Supports interrupt on Address bit
- Parallel Slave Port (PSP) module 8-bits wide, external $\overline{RD}$, $\overline{WR}$ and $\overline{CS}$ controls
- High Sink/Source Current: 25 mA

Analog Features:

- 10-bit 8-ch Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:
  - Two analog comparators
  - Programmable on-chip voltage reference (VREF) module
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs are externally accessible

Pin Diagram:



CMOS Technology:

- Low power, high speed FLASH/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low power consumption

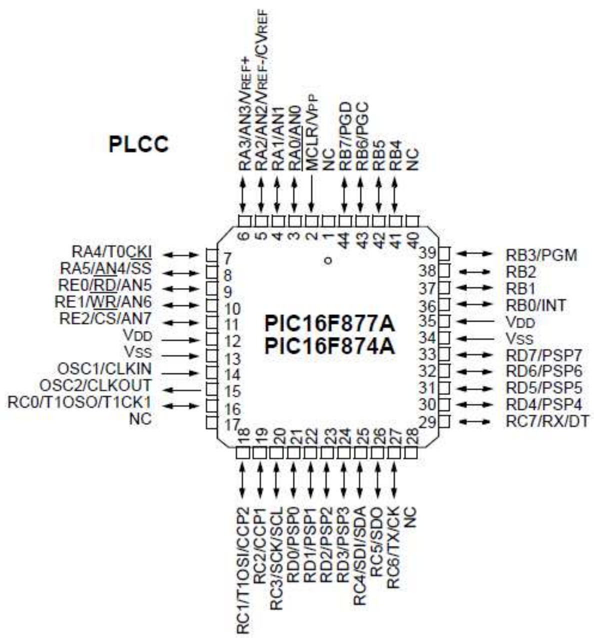
Special Microcontroller Features:

- 100,000 erase/write cycle Enhanced FLASH program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving SLEEP mode
- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

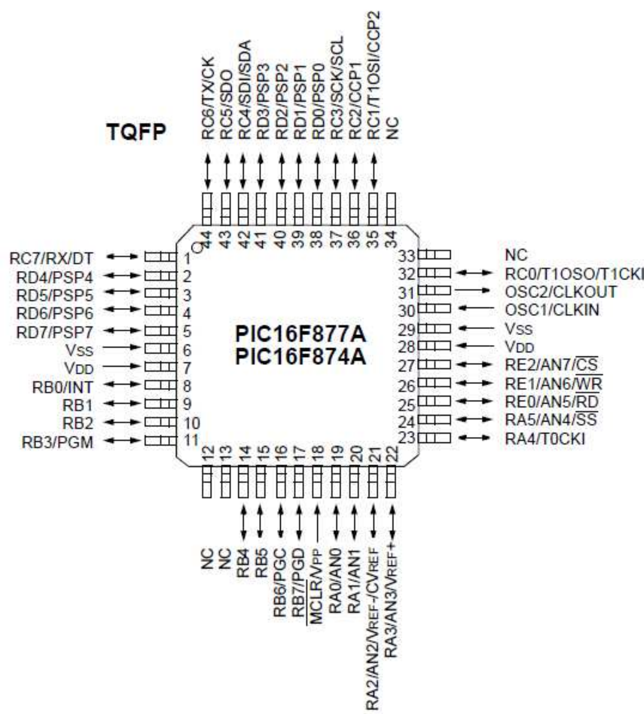
Device	Program Memory		Data SRAM (Bytes)	EEPROM (Bytes)	I/O	10-bit A/D (ch)	CCP (PWM)	MSSP		USART	Timers 8/16-bit	Comparators
	Bytes	# Single Word Instructions						SPI	Master I^2C			
PIC16F874A	7.2K	4096	192	128	33	8	2	Yes	Yes	Yes	2 / 1	2
PIC16F877A	14.3K	8192	368	256	33	8	2	Yes	Yes	Yes	2 / 1	2

Pin Diagrams:

PLCC



TQFP



Note the following details of the code protection feature on PICmicro® MCUs.

- The PICmicro family meets the specifications contained in the Microchip Data Sheet.
- Microchip believes that its family of PICmicro microcontrollers is one of the most secure products of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the PICmicro microcontroller in a manner outside the operating specifications contained in the data sheet. The person doing so may be engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable".
- Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our product.

If you have any further questions about this matter, please contact the local sales office nearest to you.

DNV Certification, Inc. USA

DNV MSC The Netherlands Accredited by the RvA

ANSI-RAB QMS ACCREDITED

DNV

ISO 9001 / QS-9000 REGISTERED FIRM

Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs and microperipheral products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.

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- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the PICmicro microcontroller in a manner outside the operating specifications contained in the data sheet. The person doing so may be engaged in theft of intellectual property.
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- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable".
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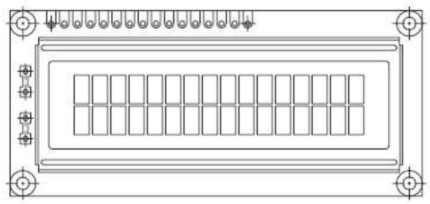
16 x 2 Character LCD



FEATURES

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

MECHANICAL DATA

ITEM	STANDARD VALUE	UNIT
Module Dimension	80.0 x 36.0	mm
Viewing Area	66.0 x 16.0	mm
Dot Size	0.56 x 0.66	mm
Character Size	2.96 x 5.56	mm

ABSOLUTE MAXIMUM RATING

ITEM	SYMBOL	STANDARD VALUE			UNIT
		MIN.	TYP.	MAX.	
Power Supply	VDD-VSS	- 0.3	–	7.0	V
Input Voltage	VI	- 0.3	–	VDD	V

NOTE: VSS = 0 Volt, VDD = 5.0 Volt

ELECTRICAL SPECIFICATIONS

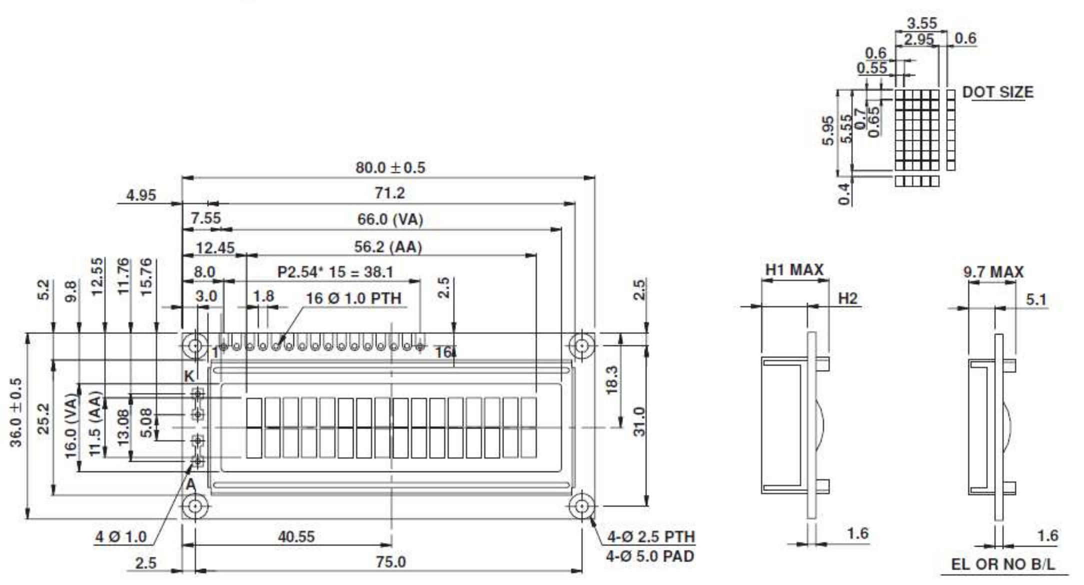
ITEM	SYMBOL	CONDITION		STANDARD VALUE			UNIT
				MIN.	TYP.	MAX.	
Input Voltage	VDD	VDD = + 5V		4.7	5.0	5.3	V
		VDD = + 3V		2.7	3.0	5.3	V
Supply Current	IDD	VDD = 5V		–	1.2	3.0	mA
Recommended LC Driving Voltage for Normal Temp. Version Module	VDD - V0	- 20 °C		–	–	–	V
		0°C		4.2	4.8	5.1	
		25°C		3.8	4.2	4.6	
		50°C		3.6	4.0	4.4	
		70°C		–	–	–	
LED Forward Voltage	VF	25°C		–	4.2	4.6	V
LED Forward Current	IF	25°C	Array	–	130	260	mA
			Edge	–	20	40	
EL Power Supply Current	IEL	Vel = 110VAC:400Hz		–	–	5.0	mA

DISPLAY CHARACTER ADDRESS CODE:

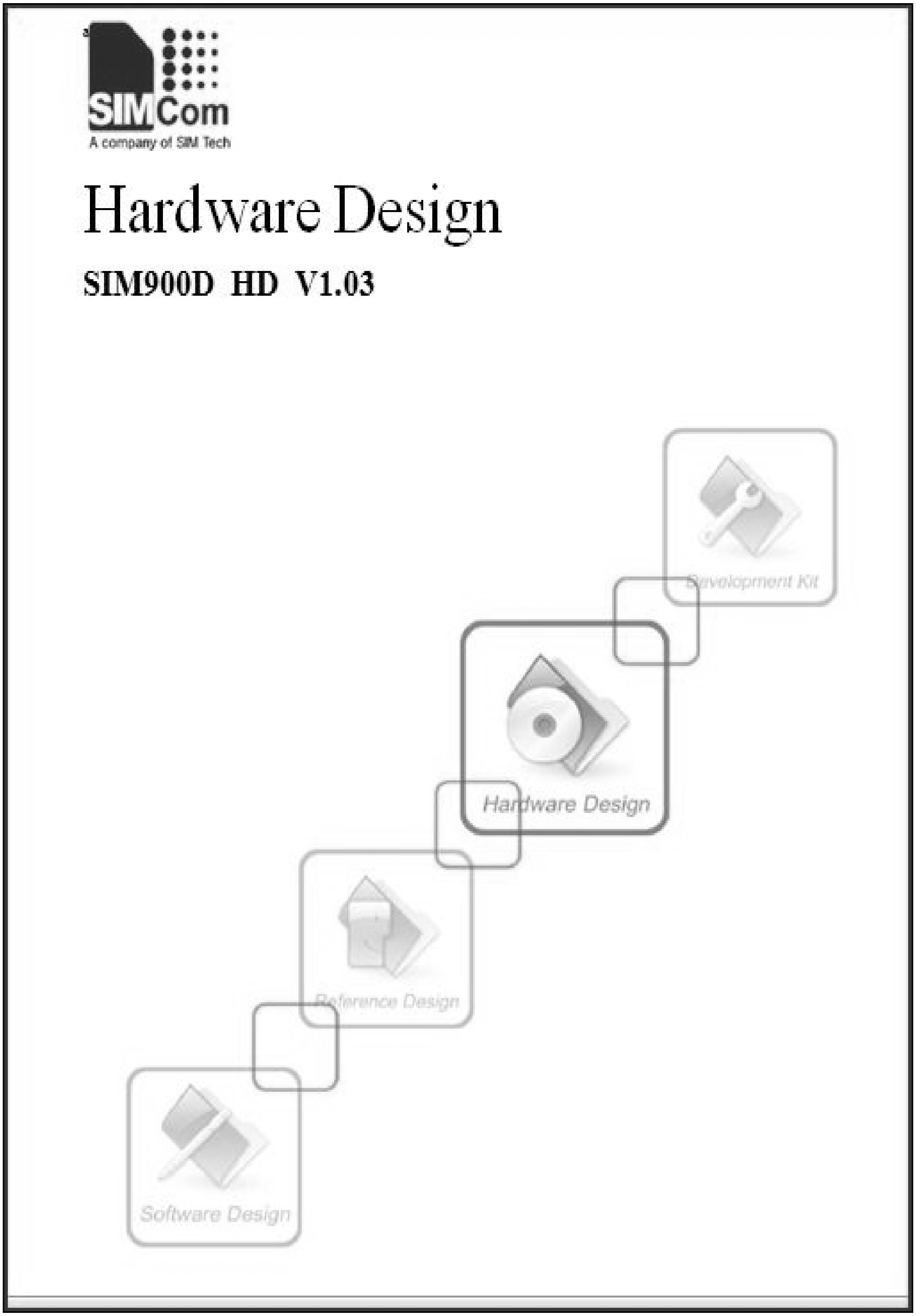
Display Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DD RAM Address	00	01														0F
DD RAM Address	40	41														4F

PIN NUMBER	SYMBOL	FUNCTION
1	Vss	GND
2	Vdd	+ 3V or + 5V
3	Vo	Contrast Adjustment
4	RS	H/L Register Select Signal
5	R/$\overline{W}$	H/L Read/Write Signal
6	E	H →L Enable Signal
7	DB0	H/L Data Bus Line
8	DB1	H/L Data Bus Line
9	DB2	H/L Data Bus Line
10	DB3	H/L Data Bus Line
11	DB4	H/L Data Bus Line
12	DB5	H/L Data Bus Line
13	DB6	H/L Data Bus Line
14	DB7	H/L Data Bus Line
15	A/Vee	+ 4.2V for LED/Negative Voltage Output
16	K	Power Supply for B/L (OV)

DIMENSIONS in millimeters



LED - H/L B/L		
	HIGH	LOW
H1	13.2	12.1
H2	8.6	7.5


SIMCom
A company of SIM Tech

Hardware Design

SIM900D HD V1.03

Document Title:	SIM900D Hardware Design
Version:	1.03
Date:	2010-06-24
Status:	Release
Document Control ID:	SIM900D_HD_V1.03

General Notes

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2 SIM900D Overview

Designed for global market, SIM900D is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900D features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 33mm x 33mm x 3mm, SIM900D can meet almost all the space requirements in your applications, such as M2M, smart phone, PDA, FWP, and other mobile device.

The physical interface to the mobile application is a 48-pin SMT pad, which provides all hardware interfaces between the module and customers' boards.

The hardware package of 48 pins

9 GND pins and 2 VBAT pins

2 pins are programmable as General Purpose I/O .This gives you the flexibility to develop customized applications.

Serial port and Debug port can develop your applications easily.

Two audio channels include two microphone inputs and two speakers' outputs. This can be easily configured by AT command.

With the charge circuit integrated inside the SIM900D, it is very suitable for the battery power application.

The SIM900D provides RF antenna interface. And customer's antenna should be located in the customer's main board and connect to module's antenna pad through micro strip line or other type RF traces whose impendence must be controlled in 50Ω.

The SIM900D is designed with power saving technique so that the current consumption is as low as 1.2mA in SLEEP mode.

The SIM900D is integrated with the TCP/IP protocol; extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

The modules are fully RoHS compliant to EU regulation.

2.1 SIM900D Key Features

Table3: SIM900D key features

Feature	Implementation
Power supply	Single supply voltage 3.1V – 4.8V
Power saving	Typical power consumption in SLEEP mode is 1.5mA (BS-PA-MFRMS=2)

Frequency Bands	SIM900D Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. The SIM900D can search the 4 frequency bands automatically. The frequency bands also can be set by AT command. Compliant to GSM Phase 2/2+
GSM class	Small MS
Transmitting power	Class 4 (2W) at GSM 850 and EGSM 900 Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	GPRS multi-slot class 10 (default) GPRS multi-slot class 8 (option) GPRS mobile station class B
Temperature range	Normal operation: -30°C to +80°C Restricted operation: -40°C to -30°C and +80°C to +85°C [1] Storage temperature -45°C to +90°C
DATA GPRS: CSD:	GPRS data downlink transfer: max. 85.6 kbps GPRS data uplink transfer: max. 42.8 kbps Coding scheme: CS-1, CS-2, CS-3 and CS-4 Supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. Integrates the TCP/IP protocol. Support Packet Switched Broadcast Control Channel (PBCCH) CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent Unstructured Supplementary Services Data (USSD) support
SMS	MT, MO, CB, Text and PDU mode SMS storage: SIM card
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: Half Rate (ETS 06.20) Full Rate (ETS 06.10) Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) Adaptive multi rate (AMR) Echo Cancellation Noise Suppression
Serial port and Debug port	Serial Port: 7-wire modem interface with status and control lines, unbalanced, asynchronous. 1.2kbps to 115.2kbps. Serial Port can be used for AT commands or data stream. Supports RTS/CTS hardware handshake and software ON/OFF flow control. Multiplex ability according to GSM 07.10 Multiplexer Protocol. Autobauding supports baud rate from 1200 bps to 57600bps.

	Debug port: 2-wire null modem interface DBG_TXD and DBG_RXD. Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 99
Real time clock	Implemented
Timer function	Programmable via AT command
Physical characteristics	Size: 33x 33 x 3 mm Weight: 6.2g
Firmware upgrade	Firmware upgrade by debug port

Note: The SIM900D does work, but deviations from the GSM specification may occur.

Table4: Coding schemes and maximum net data rates over air interface

Coding scheme	1 Timeslot	2 Timeslot	4 Timeslot
CS-1:	9.05kbps	18.1kbps	36.2kbps
CS-2:	13.4kbps	26.8kbps	53.6kbps
CS-3:	15.6kbps	31.2kbps	62.4kbps

2.2 SIM900D Functional Diagram

The following figure shows a functional diagram of the SIM900D and illustrates the mainly functional part:

The GSM baseband engine

Flash and SRAM

The GSM radio frequency part

The antenna interface

The Other interfaces

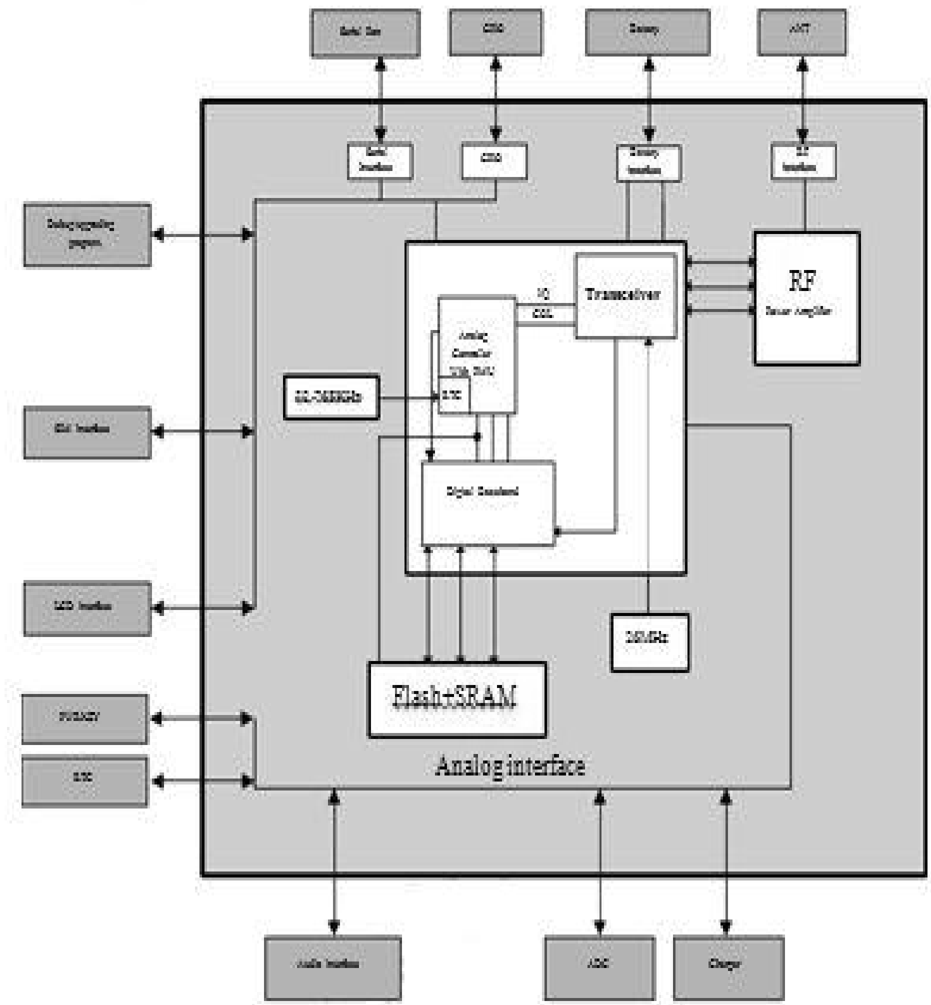


Figure1: SIM900D functional diagram

2.3 SIM900D Evaluation Board

In order to help you on the application of SIM900D, SIMCom can supply an Evaluation Board (EVB) that interfaces the SIM900D directly with appropriate power supply, SIM card holder, serial port, handset port, earphone port, antenna and all GPIO of the SIM900D.

SIM900D Hardware Design

6.2 Top and Bottom View of the SIM900D

Figure33: Top and Bottom view of the SIM900D

6.3 PIN Assignment of SIM900D

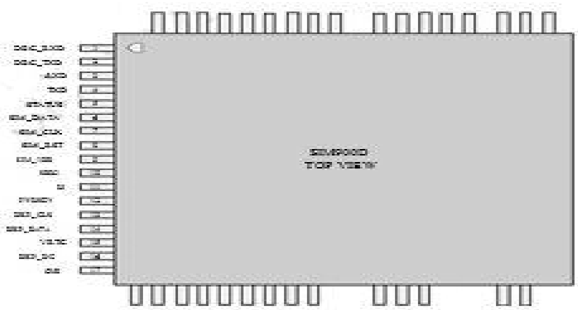


Figure34: SIM900D pin out diagram (Top View)

SIM900D Hardware Design

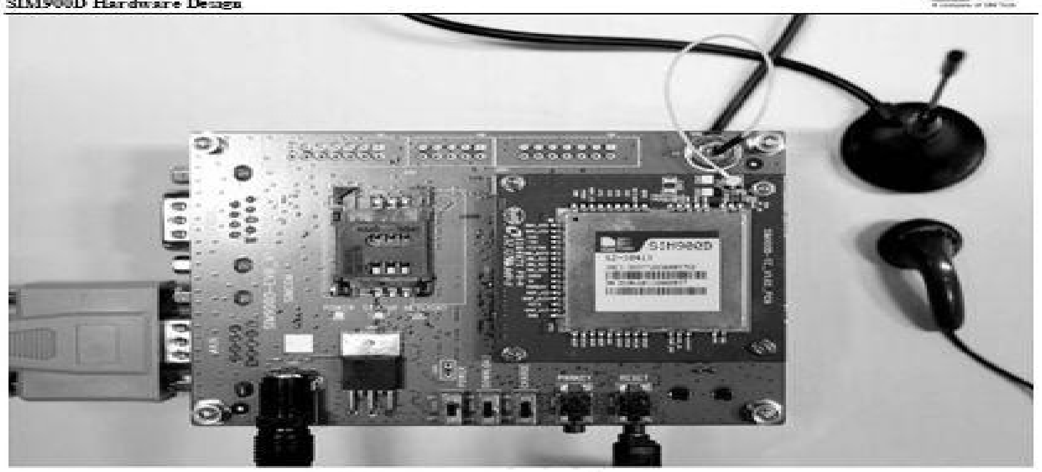


Figure2: Top view of SIM900D EVB

For details please refer to the *SIM900-EVB_UGD* document.

Table32: PIN Assignment

Pin NUM	NAME	Pin NUM	NAME
1	DBG_RXD	2	DBG_TXD
3	RXD	4	TXD
5	STATUS	6	SIM_DATA
7	SIM_CLK	8	SIM_RST
9	SIM_VDD	10	KBR0
11	RI	12	PWRKEY
13	DISP_CLK	14	DISP_DATA
15	VRTC	16	DISP_D/C
17	GND	18	MIC2P
19	MIC2N	20	MIC1N
21	MIC1P	22	AGND
23	SPK1P	24	SPK1N
25	SPK2N	26	SPK2P
27	TEMP_BAT	28	VCHG
29	ADC0	30	GND
31	GND	32	GND
33	ANT	34	GND
35	GND	36	GND
37	GND	38	VBAT
39	VBAT	40	GPO1
41	NETLIGHT	42	DCD
43	DTR	44	RTS
45	CTS	46	DISP_CS
47	PWM	48	GND

GR-89 GPS Receiver Module

■ Main Features

- SiRF GSC3f/LP chipset with embedded ARM7TDMI CPU available for customized applications in firmware.
- 20-Channel GPS Receiver for fast acquisition and reacquisition.
- Very compact size, only 25.4 * 25.4 * 3 mm.
- 200,000 effective correlators for fast Time To First Fix (TTFF), even at poor satellite signal.
- Built-in WAAS/EGNOS Demodulator.
- Low power consumption with Advanced Trickle-Power and Push-To-Fix mode.
- Support NMEA-0183 v2.2 data protocol and SiRF binary code.
- Real time navigation for location based services.
- For Car Navigation, Marine Navigation, Fleet Management, AVL and Location-Based Services, Auto Pilot, Personal Navigation or touring devices, Tracking devices/systems and Mapping devices application.

■ Specifications

- Acquisition at low signal levels:
  - Cold/Warm/Hot start: 42/38/1 sec. (average)
- Position Accuracy※:
  - Autonomous: <10 meters at 2DRMS.
  - SBAS: <7 meters at 2DRMS, WAAS corrected.
  - DGPS: 1-5 meters at DGPS corrected.
- Receiver:
  - Tracking : L1/CA code
  - Channel : 20

- Max. Update rate: 1 HZ
- Time mark output 1 pulse/sec, aligned with GPS time ±0.1 usec
- Max. Altitude/Velocity : < 60,000 ft / < 1,000 knots※.
- Protocol Support : NMEA-0183, SiRF Binary, AI3/F
- Datum: WGS-84 (default), selectable for other Datum.

- Processing Core

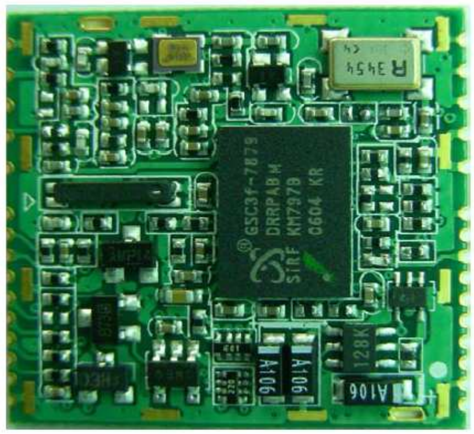
- 200,000+ effective correlators for fast TTFF and high sensitivity acquisition.
- Processor Type: ARM7TDMI
- Processor Speeds 49 MHZ
- Integrated program Flash 4Mbit
- Minimum tracking signal levels: -159 dBm※
- Interface : CMOS 3V
- Dimension: 25.4 x 25.4 x 3 mm
- Weight: 3 g
- Operating Temperature : -20 ℃to +70 ℃
- Storage Temperature: -40 ℃to +85 ℃
- Operating Humidity: 5% to 95%, No Condensing
- Power : input voltage 3.3V ~ 5.5VDC
- Operational current: less than 65 mA (without antenna)

- RF DC power supply for active antenna max 50 mA

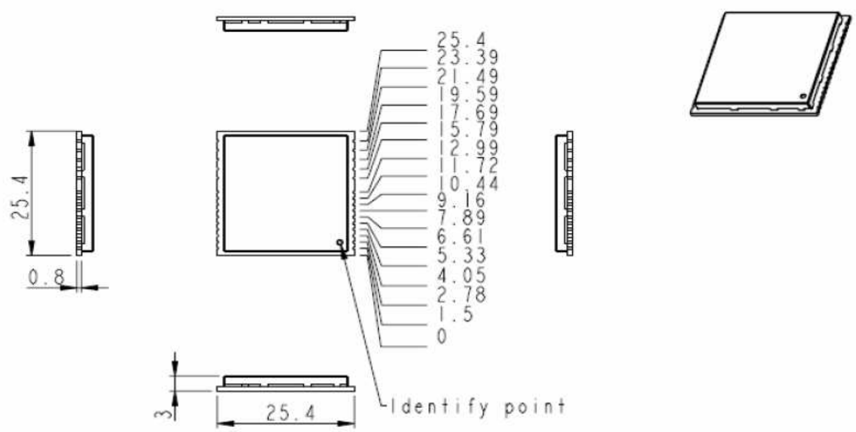
※: According to SiRF GSC3f/LP specification.

■ Module snapshot and pin out definition.

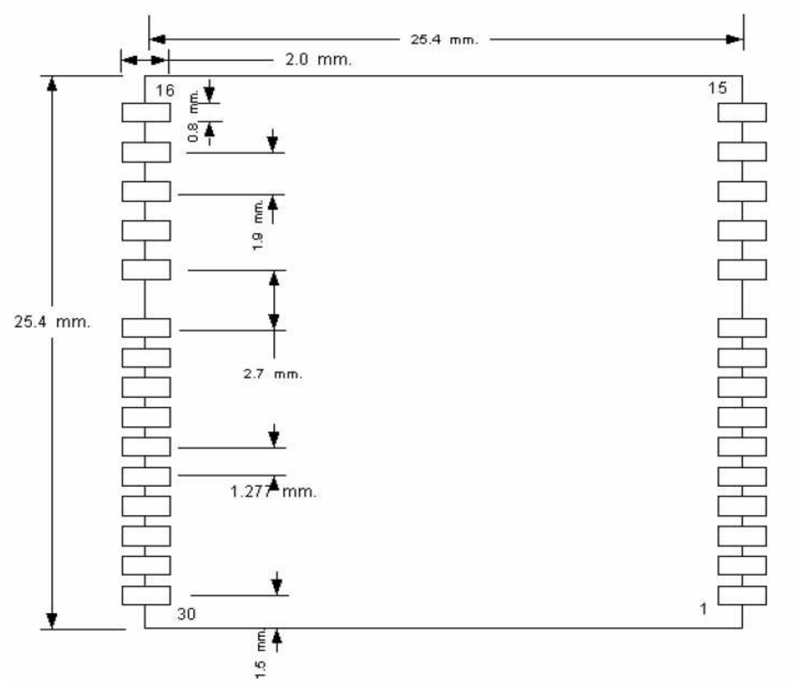
Picture



Mechanical dimension (unit mm)



Recommend PCB layout



Pin assignment

Pin	Pin Name	Type	Function description
1	***VCC_IN***	I	3.3 ~ 5 V supply input
2	***GND***	G	Ground
3	***BOOT_SEL***	I	Boot selection. Pull high this pin at power on stage for flash programming.
4	***RXDA***	I	Serial Data input A
5	***TXDA***	O	Serial Data Output A
6	***TXDB***	O	Serial Data Output B
7	***RXDB***	I	Serial Data input B
8	***GPIO14***	I/O	General purpose I/O. flash at 1Hz when position is fixed.
9	***RF_ON***	O	Indication for RF power supply. Flashes in trickle power mode.

10	***GND***	G	Ground
11	***GND***	G	Ground
12	***GND***	G	Ground
13	***GND***	G	Ground
14	***GND***	G	Ground
15	***GND***	G	Ground
16	***GND***	G	Ground
17	***RF_IN***	I	GPS signal input
18	***GND***	I	Ground
19	***V_ANT_IN***	I	Antenna power supply input
20	***VCC_RF_O***	O	Antenna power supply, 3.0V
21	***V_BAT***	I	RTC and backup SRAM power, 2.6 ~ 3.6 VDC.
22	***nRESET***	I	Reset, active low
23	***GPIO10***	I/O	General purpose I/O
24	***GPIO1***	I/O	General purpose I/O
25	***GPIO2***	I/O	General purpose I/O
26	***GPIO0***	I/O	General purpose I/O
27	***GPIO13***	I/O	General purpose I/O
28	***GPIO15***	I/O	General purpose I/O
29	***PPS***	O	1 PPS output, synchronized with GPS time. TIME_MARK 1 PPS output, 1us/s
30	***GND***	G	Ground

Future Technology Devices International Ltd.

VDIP1

Vinculum VNC1L Module

Datasheet

Document Reference No.: FT_000016

Version 1.02

Issue Date: 2010-05-31

Future Technology Devices International Ltd (FTDI)

Unit 1, 2 Seaward Place, Centurion Business Park, Glasgow, G41 1HH, United Kingdom

Tel.: +44 (0) 141 429 2777   Fax: + 44 (0) 141 429 2758

E-Mail (Support): support1@ftdichip.com

Web: http://www.vinculum.com

1 Introduction

The VDIP1 module is an MCU to embedded USB host controller development module for the VNC1L IC device. The VDIP1 is supplied on a PCB designed to fit into a 24 pin DIP socket, and provides access to the UART, parallel FIFO, and SPI interface pins on the VNC1L device, via its AD and AC bus pins. Not only is it ideal for developing and rapid prototyping of VNC1L designs, but also an attractive quantity discount structure makes this module suitable for incorporation into low and medium volume finished product designs.

Figure 1.1- VDIP1

The Vinculum VNC1L is the first of FTDI's Vinculum family of Embedded USB host controller integrated circuit devices. Not only is it able to handle the USB Host Interface, and data transfer functions but owing to the inbuilt MCU and embedded Flash memory, Vinculum can encapsulate the USB device classes as well. When interfacing to mass storage devices such as USB Flash drives, Vinculum also transparently handles the FAT File structure communicating via UART, SPI or parallel FIFO interfaces via a simple to implement command set. Vinculum provides a new cost effective solution for providing USB Host capability into products that previously did not have the hardware resources available. The VNC1L is available in Pb-free (RoHS compliant) compact 48-Lead LQFP package.

2 Features

The VDIP1 has the following features:

- Uses FTDI's VNC1L embedded dual USB host controller IC device
- USB single 'A' type USB socket to interface with USB peripheral devices
- Second USB interface port available via module pins if required
- Jumper selectable UART, parallel FIFO or SPI MCU interfaces
- Single 5V supply input from USB connection (no external supply necessary)
- Auxiliary 3.3 V / 200 mA power output to external logic.
- Program or update firmware via USB Flash disk or via UART/Parallel FIFO/SPI interface
- Power and traffic indicator LED's
- VNC1L firmware programming control pins PROG# and RESET# brought out onto jumper interface
- VDIP1 is a Pb-free, RoHS complaint development module.
- Schematics, and firmware files available for download from the Vinculum website

3 Pin Out and Signal Description

3.1 Module Pin Out

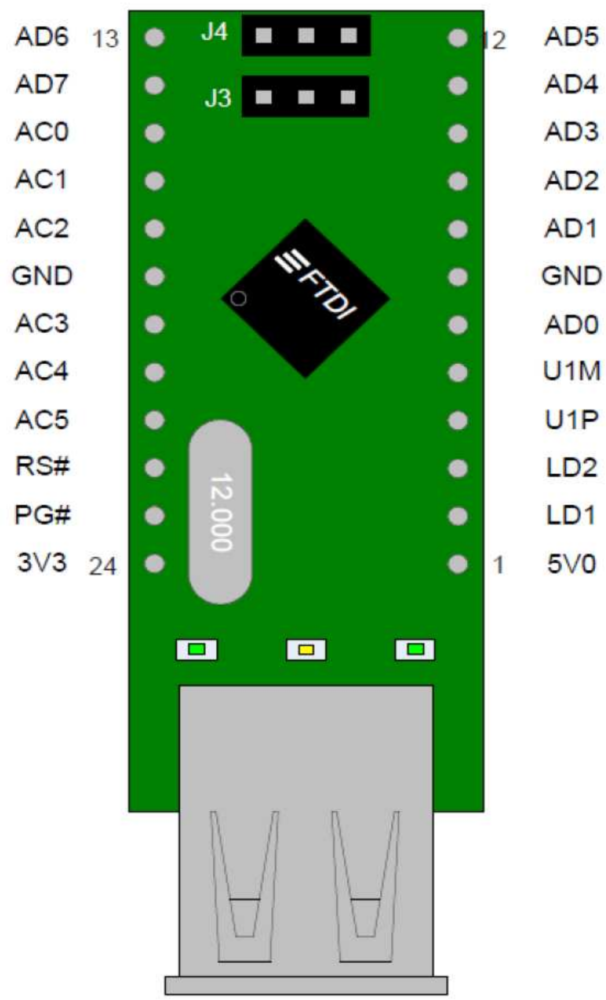


Figure 3.1 - VDIP1 Module Pin Out (Top View)

3.2 Pin Signal Description

Pin No.	Name	Pin Name on PCB	Type	Description
1	5V0	5V0	PWR Input	5.0 V module supply pin. This pin provides the 5.0V output on the USB 'A' type socket, and also the 3.3V supply to VNCL2, via an on-board 3.3 V L.D.O.
2	LED1	LD1	Output	USB port 1 traffic activity indicator LED. This pin is hard wired to a green LED on board the PCB. It is also brought out onto this pin which allows for the possibility of bring- ing out an additional LED traffic indicator out of the VDIP1 board. For example, if the VDIP1 USB connector is brought out onto an instrument front panel, an activity LED could be mounted along side it.
3	LED2	LD2	Output	USB port 2 traffic activity indicator LED. This pin is hard wired to a green LED on board the PCB. It is also brought out onto this pin which allows for the possibility of bring- ing out an additional LED traffic indicator out of the VDIP1 board. For example, if the VDIP1 USB connector is brought out onto an instrument front panel, an activity LED could be mounted along side it.
4	USBD1P	U1P	I/O	USB host / slave port 1 - USB Data Signal Plus with integrated pull up / pull down resistor. Module has on board 27 Ω USB series resistor. This pin can be brought out along with pin 5 to provide a second USB port, if required
5	USBD1M	U1M	I/O	USB host / slave port 1 - USB Data Signal Minus with integrated pull up / pull down resistor. Module has on board 27 Ω USB series resistor. This pin can be brought out along with pin 4 to provide a second USB port, if required
6	ADBUS0	AD0	I/O	5V safe bidirectional data / control bus, AD bit 0
7	GND	GND	PWR	Module ground supply pin
8	ADBUS1	AD1	I/O	5V safe bidirectional data / control bus, AD bit 1
9	ADBUS2	AD2	I/O	5V safe bidirectional data / control bus, AD bit 2
10	ADBUS3	AD3	I/O	5V safe bidirectional data / control bus, AD bit 3
11	ADBUS4	AD4	I/O	5V safe bidirectional data / control bus, AD bit 4
12	ADBUS5	AD5	I/O	5V safe bidirectional data / control bus, AD bit 5
13	ADBUS6	AD6	I/O	5V safe bidirectional data / control bus, AD bit 6
14	ADBUS7	AD7	I/O	5V safe bidirectional data / control bus, AD bit 7
15	ACBUS0	AC0	I/O	5V safe bidirectional data / control bus, AC bit 0
16	ACBUS1	AC1	I/O	5V safe bidirectional data / control bus, AC bit 1
17	ACBUS2	AC2	I/O	5V safe bidirectional data / control bus, AC bit 2
18	GND	GND	PWR	Module Ground Supply Pin
19	ACBUS3	AC3	I/O	5V safe bidirectional data / control bus, AC bit 3
20	ACBUS4	AC4	I/O	5V safe bidirectional data / control bus, AC bit 4
21	ACBUS5	AC5	I/O	5V safe bidirectional data / control bus, AC bit 5
22	RESET#	RS#	Input	Can be used by an external device to reset the VNC1L. This pin can be used in combination with PROG# and the UART / parallel FIFO / SPI interface to program firmware into the Vinculum
23	PROG#	PG#	Input	This pin is used in combination with the RESET# pin and the UART / parallel FIFO / SPI interface to pro gra m fir mware into t he VNC1L.
24	3V3	3V3	PWR	3.3V output from VDIP1's on board 3.3V L.D.O.

Table 3.1 - Pin Signal Descriptions

3.3 I/O Configuration Using The Jumper Pin Header

Two three way jumper pin headers are provided to allow for simple configuration of the I/O on data and control bus pins of the VDIP1. This is done by a combination of pulling up or pulling down the VNC1L ACBUS5 (pin 46) and ACBUS6 (pin 47). The relevant portion of the VDIP1 module schematic is shown in **Figure 3.2**

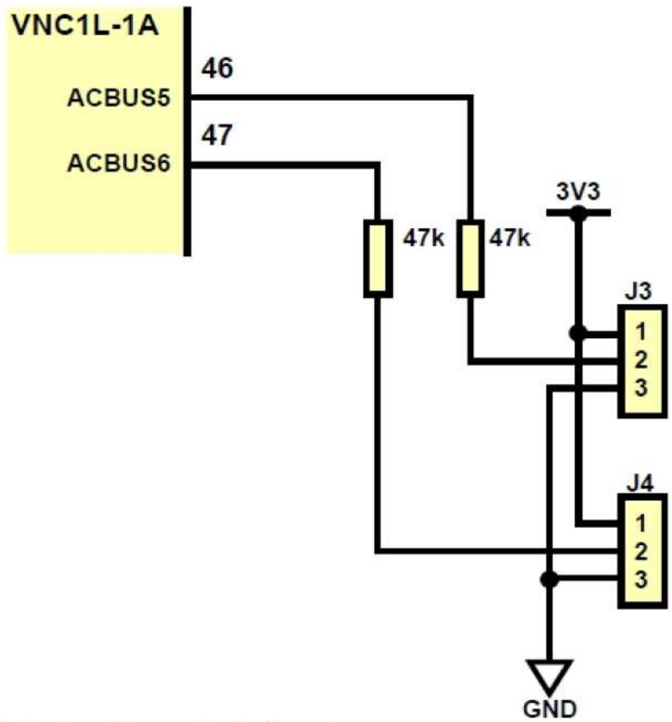


Figure 3.2 – VDIP1 On-Board Jumper Pin Configuration.

ACBUS6 (VNC1L pin 47)	*ACBUS5 (VNC1L pin 46)*	*I/O Mode*
Pull-Up	Pull-Up	Serial UART
Pull-Up	Pull-Down	SPI
Pull-Down	Pull-Up	Parallel FIFO
Pull-Down	Pull-Down	Serial UART

Table 3.2 - VDIP1 Port Selection Jumper Pins

3.4 Default Interface I/O Pin Configuration

The VNC1L device is pre-programmed with default settings for the I/O pins however they can be easily changed to suit a designers needs. The default interface I/O pin configuration of the VNC1L device are shown in **Table 3.3**

Pin No.	*Name*	*Pin Name on PCB*	*Type*	*Description*	*Data and Control Bus Configuration Options*			
					UART Interface	*Parallel FIFO Interface*	*SPI Slave Interface*	*I/O Port*
6	ADBUS0	AD0	I/O	5V safe bidirectional data / control bus, AD bit 0	TXD	D0	SCLK	PortAD0
8	ADBUS1	AD1	I/O	5V safe bidirectional data / control bus, AD bit 1	RXD	D1	SDI	PortAD1
9	ADBUS2	AD2	I/O	5V safe bidirectional data / control bus, AD bit 2	RTS#	D2	SDO	PortAD2
10	ADBUS3	AD3	I/O	5V safe bidirectional data / control bus, AD bit 3	CTS#	D3	CS	PortAD3
11	ADBUS4	AD4	I/O	5V safe bidirectional data / control bus, AD bit 4	DTR#	D4		PortAD4
12	ADBUS5	AD5	I/O	5V safe bidirectional data / control bus, AD bit 5	DSR#	D5		PortAD5
13	ADBUS6	AD6	I/O	5V safe bidirectional data / control bus, AD bit 6	DCD#	D6		PortAD6
14	ADBUS7	AD7	I/O	5V safe bidirectional data / control bus, AD bit 7	RI#	D7		PortAD7
15	ACBUS0	AC0	I/O	5V safe bidirectional data / control bus, AC bit 0	TXDEN#	RXF#		PortAC0
16	ACBUS1	AC1	I/O	5V safe bidirectional data / control bus, AC bit 1		TXE#		PortAC1
17	ACBUS2	AC2	I/O	5V safe bidirectional data / control bus, AC bit 2		RD#		PortAC2
19	ACBUS3	AC3	I/O	5V safe bidirectional data / control bus, AC bit 3		WR		PortAC3
20	ACBUS4	AC4	I/O	5V safe bidirectional data / control bus, AC bit 4				PortAC4

Table 3.3 - Default Interface I/O Pin Configuration

3.5 Signal Descriptions - UART Interface

The UART interface I/O pin description of the VNC1L device are shown in **Table 3.4**

Pin No.	Name	Type	Description
6	TXD	Output	Transmit asynchronous data output
8	RXD	Input	Receive asynchronous data input
9	RTS#	Output	Request To Send Control Output / Handshake signal
10	CTS#	Input	Clear To Send Control Input / Handshake signal
11	DTR#	Output	Data Terminal Ready Control Output / Handshake signal
12	DSR#	Input	Data Set Ready Control Input / Handshake signal
13	DCD#	Input	Data Carrier Detect Control Input
14	RI#	Input	Ring Indicator Contro l Input. When the RemoteakeW up option is enabled in the EEPROM, taking RI# low can be used to resume the PC USB Host controller from suspend
15	TXDEN#	Input	Enable Transmit Data for RS485 designs

Table 3.4 - Default I/O Pin Configuration – UART Interface

3.6 Signal Descriptions – Serial Peripheral Interface (SPI)

The SPI I/O pin description of the VNC1L device are shown in **Table 3.5**

Pins No	*Name*	*Type*	*Description*
6	SCLK	Input	SPI Clock input, 12MHz maximum.
8	SDI	Input	SPI Serial Data Input
9	SDO	Output	SPI Serial Data Output
10	CS	Input	SPI Chip Select Input

Table 3.5 - Data and Control Bus Signal Mode Options – SPI Slave Interface

3.6.1 SPI Slave Data Read Cycle

When in SPI mode, the timing of a read operation is shown in Figure 3.3

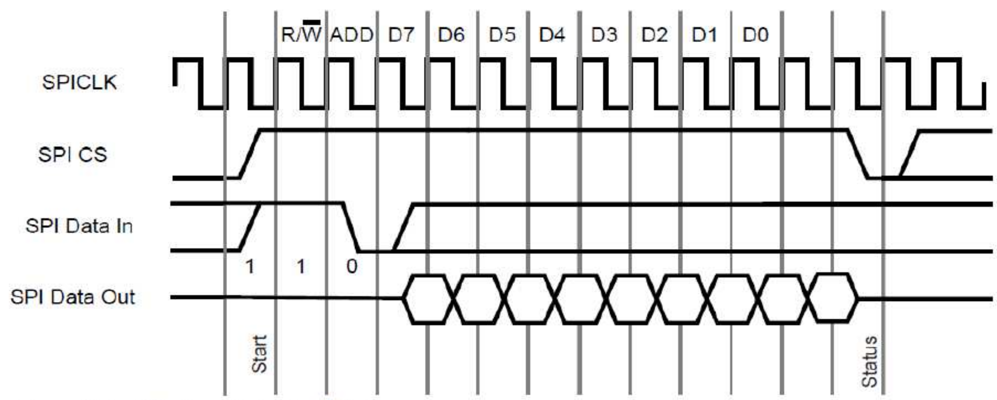


Figure 3.3 – SPI Slave Data Read Cycle.

From Start - SPI CS must be held high for the entire read cycle, and must be taken low for at least one clock period after t he read is co mpleted. The first bit on SPI Data In is the R/W bit - inputting a '1' here a llows data to be read fro m the chip. The next bit is the address bit, ADD, which is used to indicate whether the data register ('0') or the status register ('1') is read from. During the SPI read cycle a byte of data will start being output on SPI Data Out on the next clock cycle after t he address bit, MSBAfterfirst.t he data has been clocked out of the chip, t he status of SPI Data. Out should be checked to see if the data read is new data. A '0' level here on SPI Data Out means that the data read is new data. A '1' indicates that the data read is old data, and the read cycle should be repeated to get new data. Remember that CS must be held low for at least one clock period before being taken high again to continue with the next read or write cycle.

3.6.2 SPI Slave Data Write Cycle

When in SPI mode, the timing of a write operation is shown in

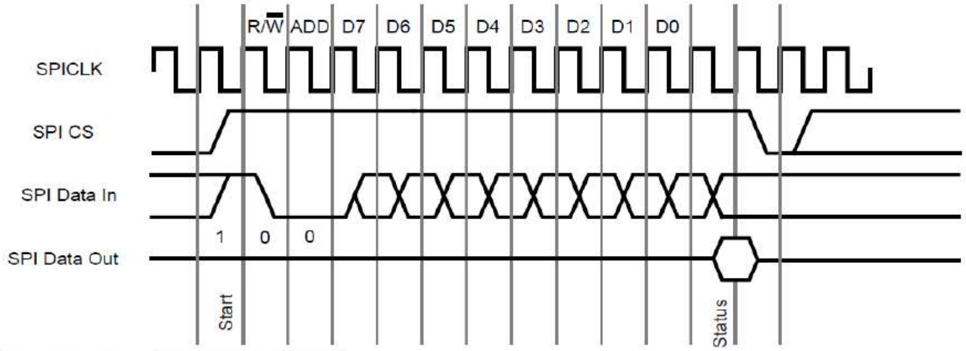


Figure 3.4 – SPI Slave Data Write Cycle.

From Start - SPI CS must be held high for the entire write cycle, and must be taken low for at least one clock period after t he write is co mpletedThe. first bit on SPI Data In is the R/W bit - inputting a '0' here a llows data to be written to the chip. The next bit is the address bit, ADD, which is used to indicate whether the data register ('0') or the status register ('1') is written to. During the SPI write cycle a byte of data can be input to SPI Data In on the next clock cycle after t he address bit, MSBAfterfirst.t he data has been clocked in to the chip, t he status of SPI Data Out should be checked to see if the data read was accepted. A '0' level on SPI Data Out means that the data write was accepted. A '1' indicates that the internal buffer is full, and the write should be repeated. Remember that CS must be held low for at least one clock period before being taken high again to continue with the next read or write cycle.

3.6.3 SPI Slave Data Timing Diagrams

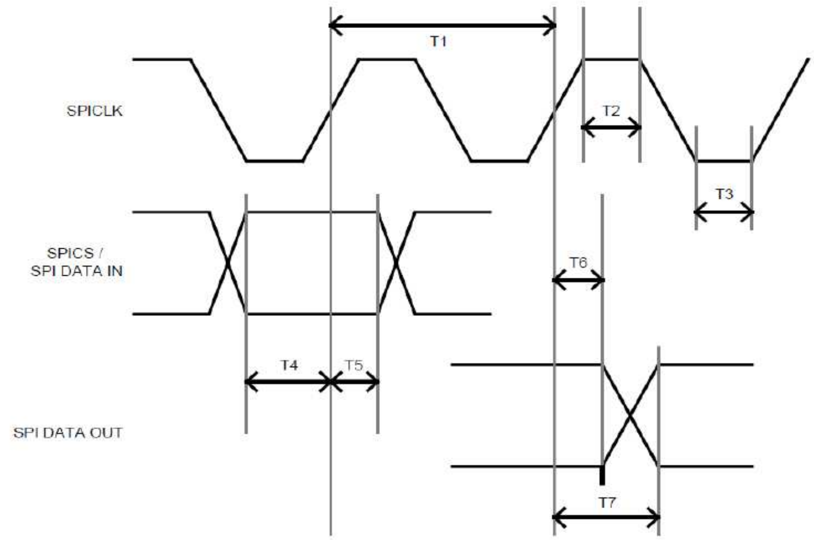


Figure 3.5 – SPI Slave Data Timing Diagrams.

Time	Description	Min	Typical	Max	Unit
T1	SPICLK Period	83	-	-	ns
T2	SPICLK High	20	-	-	ns
T3	SPICLK Low	20	-	-	ns
T4	Input Setup Time	10	-	-	ns
T5	Input Hold Time	10	-	-	ns
T6	Output Hold Time	2	-	-	ns
T7	Output Valid Time	-	-	20	ns

Table 3.6 - SPI Slave Data Timing

Time	Description
T1	RXF#
T2	TXE#
T3	-
T4	-
T5	RXF IRQEn
T6	TXE IRQEn
T7	-

Table 3.7 - SPI Slave Status Register (ADD='1')

3.7 Signal Descriptions - Parallel FIFO Interface

The Parallel FIFO interface I/O pin description of the VNC1L device is shown in **Table 3.8**

Pin No.	Name	Type	Description
6	D0	I/O	FIFO Data Bus Bit 0
8	D1	I/O	FIFO Data Bus Bit 1
9	D2	I/O	FIFO Data Bus Bit 2
10	D3	I/O	FIFO Data Bus Bit 3
11	D4	I/O	FIFO Data Bus Bit 4
12	D5	I/O	FIFO Data Bus Bit 5
13	D6	I/O	FIFO Data Bus Bit 6
14	D7	I/O	FIFO Data Bus Bit 7
15	RXF#	OUTPUT	When high, do not read data from the FIFO. When low, there is data available in the FIFO which can be read by stro bing RD# low, t hen high again.
16	TXE#	OUTPUT	When high, do not write data into the FIFO. When low, data can be written into the FIFO by strobing WR high, then low.
17	RD#	INPUT	Enables the current FIFO data byte on D0...D7 when low. Fetched the next FIFO data byte (if avail- able) fro m the recei ve FIFO buffer w hen RD# goes fro m high to low
19	WR	INPUT	Writes the data byte on the D0...D7 pins into the transmit FIFO buffer when WR goes from high to low.

Table 3.8 - Default Interface I/O Pin Configuration Option – Paralle FIFO Interface

3.7.1 Timing Diagram – Parallel FIFO Read Transaction

When in parallel FIFO interface mode, the timing of a read is shown in **Figure 3.6** and **Table 3.9**

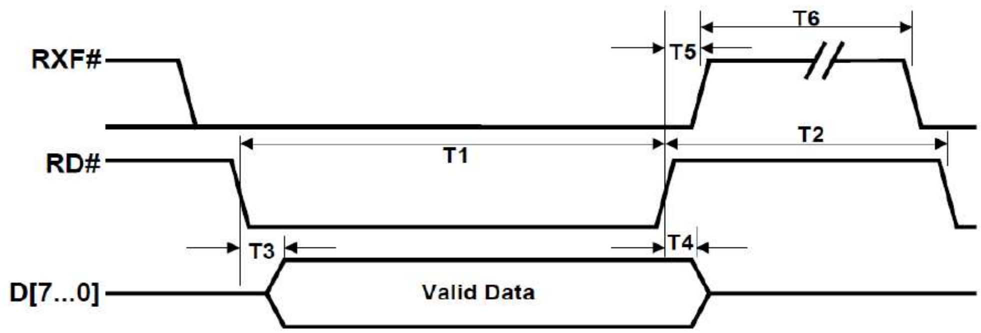


Figure 3.6 - FIFO Read Cycle.

Time	Description	Min	Max	Unit
T1	RD# Active Pulse Width	50	-	ns
T2	RD# to RD# Pre-Charge Time	50 + T6	-	ns
T3	RD# Active to Valid Data*	20	50	ns
T4	Valid Data Hold Time from RD#	0	-	ns
T5	RD# Inactive to RXF#	0	25	ns
T6	RXF# Inactive After RD# Cycle	80	-	ns

Table 3.9 FIFO Read Cycle Timing

* Load = 30pF

3.7.2 Timing Diagram - Parallel FIFO Write Transaction

When in parallel FIFO interface mode, the timing of a write operation is shown in **Figure 3.7** and **Table 3.10**

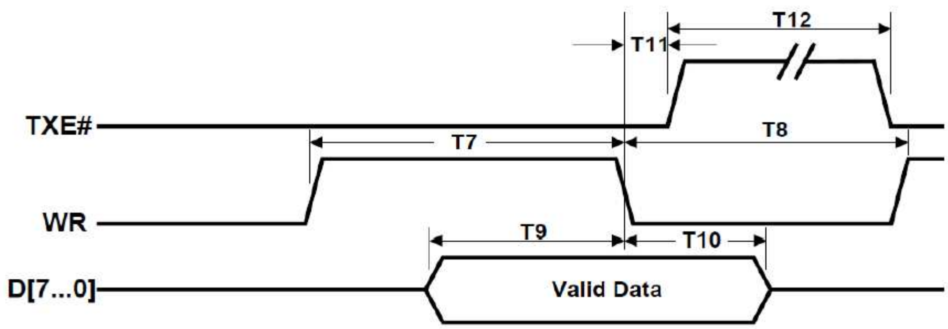


Figure 3.7 - FIFO Write Cycle.

Time	*Description*	*Min*	*Max*	*Unit*
T7	WR Active Pulse Width	50	-	ns
T8	WR to WR Pre-Charge Time	50	-	ns
T9	WR Active to Valid Data	20	-	ns
T10	Data Hold Time from WR	0	-	ns
T11	WR Inactive to TXE#	5	25	ns
T12	TXE# Inactive After WR Cycle	80	-	ns

Table 3.10 - FIFO Write Cycle Timing

4 Firmware

4.1.1 Firmware Support

There are currently 6 standard firmware versions available for VDIP1 module which can be downloaded from the FTDI website.

- VDAP Firmware: USB Host for single Flash Disk and General Purpose USB peripherals. Selectable UART, FIFO or SPI interface command monitor.
- VDPS Firmware: USB Host for single Flash Disk and General Purpose USB peripherals. USB Slave port connection for connecting to host PC. Selectable UART, FIFO or SPI interface command monitor.
- VDFC Firmware: USB Host for two Flash Disks, Selectable UART, FIFO or SPI interface command monitor.
- VCDC Firmware: USB Host for automatic connection to USB Communications Class Devices. UART interface command monitor.
- VDIF Firmware: USB Host for single Flash Disk and General Purpose USB peripherals. Selectable UART, FIFO, SPI or USB interface command monitor.

4.1.2 Firmware Upgrades

The VDIP1 module is supplied pre-loaded with the VDAP firmware.

There are two methods of upgrading the firmware on the VDIP1. These methods are described in a Vinculum Firmware manual please refer to:-

http://www.vinculum.com/documents/fwspecs/UM_VinculumFirmware_V205.pdf

5 Mechanical Dimensions

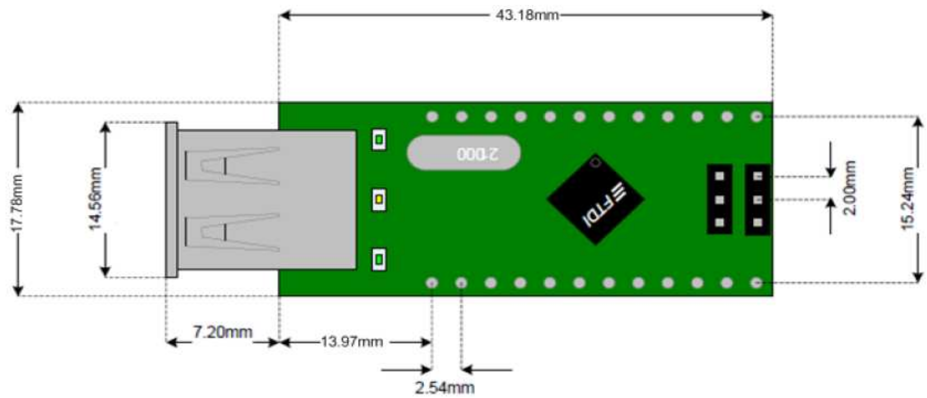


Figure 5.1 VDIP1 Dimensions (Top View)

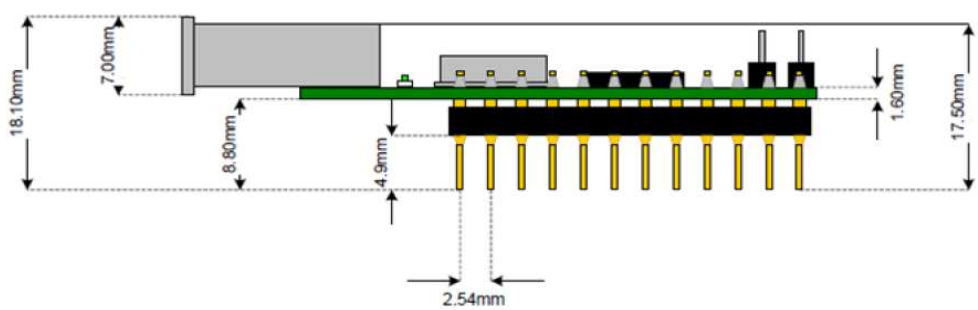


Figure 5.2 VDIP1 Dimensions (Side View)

6 External circuit Configuration

6.1 Adding a second USB Port

The external circuit configuration for adding second USB host port, with the USB activity LED, is shown below in Figure 6.1

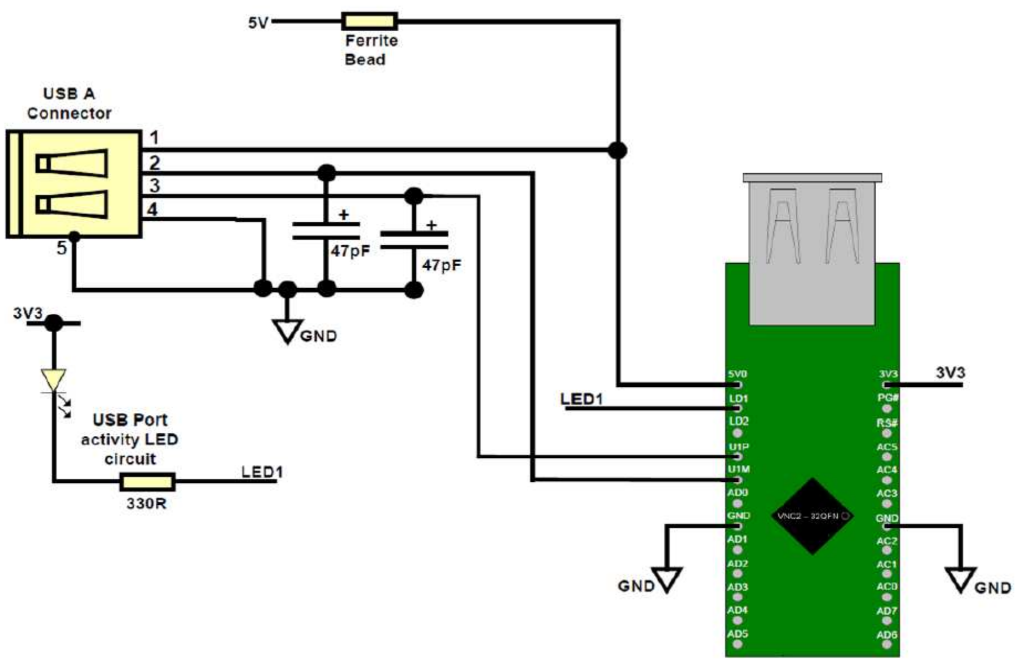
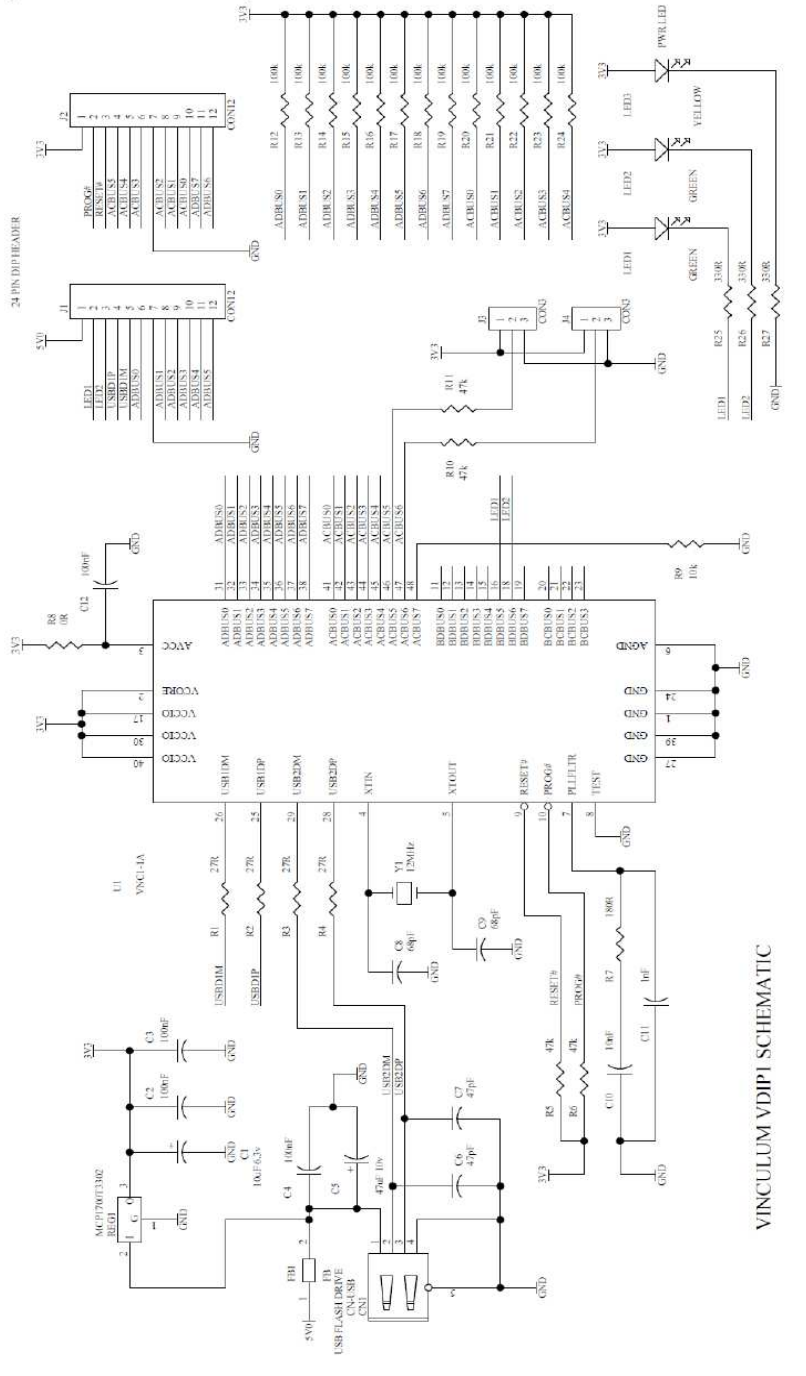


Figure 6.1 Additional USB Port Configuration

Figure 7.1 - Schematic Diagram



Preliminary

SCA1000 and SCA1020 Series

Accelerometer

FEATURES

- 2-axis measurement: SCA1000 for X - Y measurement and SCA1020 for Z - Y measurement
- Available range ±1.7 g
- Interchangeable with SCA610/SCA620 (see interchangeability drawing below)
- Over damped sensing element to control frequency response
- SMD DIL-12 lead-free component
- Compatible with lead-free reflow soldering process
- Advanced internal and external connection failure detection
- Digitally activated electrostatic self-test
- Continuous memory parity check
- Single +5 V supply; two ratiometric analog voltage outputs
- Serial Peripheral Interface (SPI) compatible digital output (11 bits)
- Internal temperature sensor, accessible via SPI

BENEFITS

- Excellent reliability and stability over time and temperature
- High resolution and low noise
- Wide operating temperature range
- Outstanding overload and shock durability

APPLICATIONS

- 2-axis acceleration measurements
- 2-axis platform leveling
- Inclination based position measurement
- 360 ° vertical orientation measurement

For customized product, please contact VTI Technologies

ELECTRICAL CHARACTERISTICS

Parameter	Condition	Min	Typ.	Max	Units
Supply voltage Vdd [1]		4.75	5.0	5.25	V
Current consumption	Vdd = 5 V; No load			5	mA
Analog resistive output load	Vout to Vdd or Vss	10			kOhm
Analog capacitive output load				20	nF
Digital output load	@ 500 kHz			1	nF
SPI clock frequency				500	kHz
AD conversion time			150		µs
Data transfer time	@500 kHz clock		38		µs

PERFORMANCE CHARACTERISTICS

Parameter	Condition	SCA1000-D01	SCA1020-D02	Units
Measuring range [2]	Nominal	±1.7	±1.7	g
Measuring direction relative to mounting plane [12]	See note 12.	"X"= parellel "Y" =parallel	"Z"= perpendicular "Y"= parallel	
Zero point [3,12]	Mounting position	Vdd/2	Vdd/2	V
Sensitivity [4,12]	@ room temperature	1.2	1.2	V/g
Zero point error over temperature [5]	-25...85 °C typical	±70	±70	mg
	-40...125 °C	±100	±100	mg
Sensitivity error over temperature [6]	-25...85 °C typical	±3	±3	%
	-40...125 °C	±4	±4	%
Typical non-linearity [7]	Over measuring range	±20	±20	mg
Cross-axis sensitivity [10]	@ room temperature	3.5	3.5	%
Frequency response -3dB [8]	@ -40...125 °C	50±30 Hz	50±30 Hz	Hz
Ratiometric error [9]	Vdd = 4.75...5.25 V	2	2	%
Output noise density [11]	From DC...100 Hz	80	80	µg/√Hz
Digital output resolution	FS	11	11	Bits

VDD = 5.00V, UNLESS OTHERWISE SPECIFIED

Note 1 100 nF supply by-pass capacitor is needed.

Note 2 Measuring directions in parallel to mounting plane, arrows showing positive acceleration direction.

Note 3 Zero point specified as Voffset = Vout(0 g) [V]. See note 12.

Note 4 Sensitivity specified as Vsens = {Vout(+1 g) - Vout(-1 g)}/2 [V/g]. See note 12.

Note 5 Zero point error specified as Zero point error = {Vout(0 g) - Vdd/2} / Vsens [g] VSens = Nominal sensitivity Vdd/2 = Nominal offset.

Note 6 Sensitivity error specified as Sensitivity error = { [Vout(+1 g)-Vout(-1 g)] / 2 - Vsens_nom} / Vsens_nom x 100 % [%] Vsens_nom = nominal sensitivity See note 12.

Note 7 From straight line through +1 g and -1 g points.

Note 8 The output has true DC (0 Hz) response.

Note 9 The ratiometric error is specified as: $RE = 100\% \times \left(1 - \frac{Vout(@Vx) \times \frac{5.00V}{Vx}}{Vout(@5V)} \right)$

Note 10 The cross-axis sensitivity determines how much acceleration, perpendicular to the measuring axis, couples to the output. The total crossaxis sensitivity is the geometric sum of the sensitivities of the two axis which are perpendicular to the measuring axis. The angular alignment error between channels 1 and 2 is included into the cross axis error.

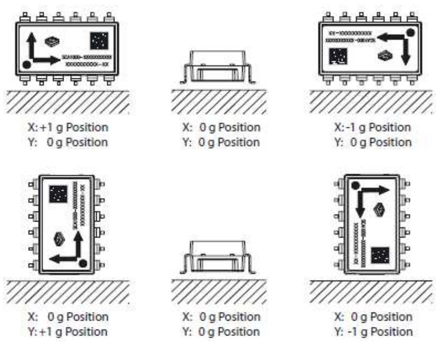
Note 11 Typical figure. In addition, supply voltage noise couples to the output due to the ratiometric nature of the accelerometer.

Note 12 Measuring directions.

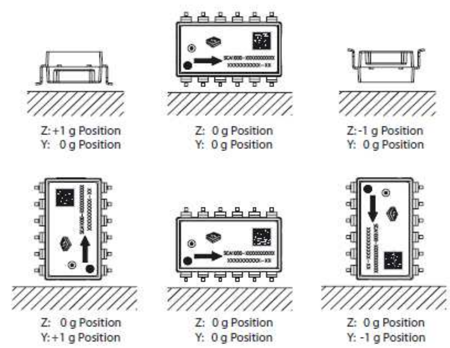
VTI TECHNOLOGIES

MEASURING DIRECTIONS

SCA1000 (X - Y Configuration)



SCA1020 (Z - Y Configuration)



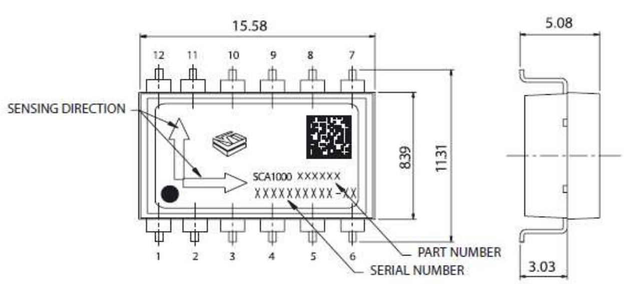
ABSOLUTE MAXIMUM RATINGS

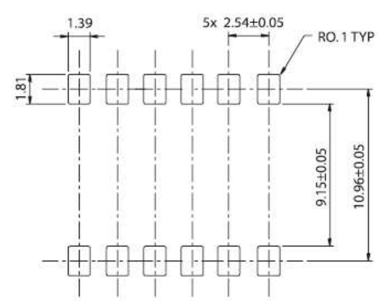
Parameter	Value	Unit
Acceleration (powered or non powered)	20 000	g
Supply voltage	-0.3 V to +5.5 V	V
Voltage at input/output pins	-0.3 V to (Vdd+0.3 V)	V
Storage temperature range	-55...125	°C

DIMENSIONS

PCB PAD LAYOUTS

The accelerometer weighs <1.2 g.
The size of the part is approximately (w x h x l) 9 x 5 x 16 mm. Pin pitch is standard 100 mils.





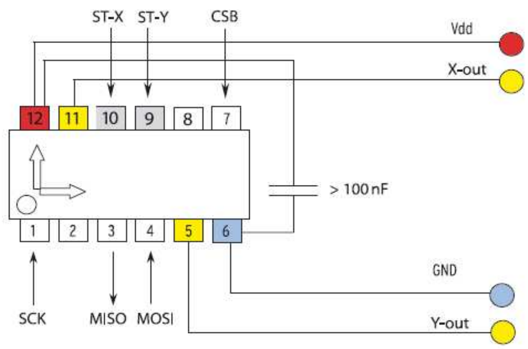
Acceleration in the direction of the arrow
will increase the output voltage.

ELECTRICAL CONNECTION

Pin#	Pin Name	I/O	Connection
1	SCK	Input	Serial clock
2		NC	Factory only
3	MISO	Output	Master in slave out; data output
4	MOSI	Input	Master out slave in; data input
5	Out_2	Output	Channel 2 Output (Y-axis)
6	VSS	Power	Negative supply voltage (VSS)
7	CSB	Input	Chip select (active low)
8		NC	Factory only
9	ST_2	Input	Self test input for Channel 2
10	ST_1	Input	Self test input for Channel 1
11	Out_1	Output	Channel 1 output (X or Z-axis)
12	VDD	Power	Positive supply voltage (VDD)

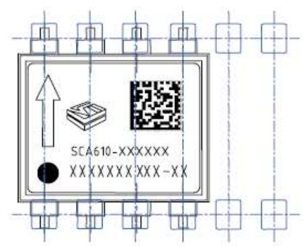
Self test can be activated applying logic "1" (positive supply voltage level) to ST pin (pin 9 and 10). If ST feature is not used pins 9 and 10 must be left floating or connected to GND.

RECOMMENDED CIRCUIT



INTERCHANGEABILITY WITH SCA610 / SCA620

When SCA1000 / 1020 is used in Analog mode and the PCB is designed correctly the SCA610 / 620 and SCA1000 / 1020 are interchangeable. If the PCB layout is designed for SCA1000 /1020, then SCA610 / 620 can be used for single axis applications. The output of SCA610 / 620 corresponds to the output of channel 1 in the SCA1000 / 1020.



VTI Technologies Oy
Myllynkivenkuja 6
P.O. Box 27
FI-01621 Vantaa
Finland
Tel. +358 9 879 181
Fax +358 9 879 18791
sales@vti.fi

VTI Technologies Oy
Frankfurt Branch
Rennbahnstr. 72-74
D-60528 Frankfurt am Main
Germany
Tel. +49 69 6786 880
Fax +49 69 6786 8829
sales.de@vti.fi

VTI Technologies, Inc.
One Park Lane Blvd.
Suite 804 - East Tower
Dearborn, MI 48126
USA
Tel. +1 313 425 0850
Fax +1 313 425 0860
sales@vtitechnologies.com

VTI TECHNOLOGIES

D. Others (Program Listing)

Microcontroller:

```
Device 16F877A
	Declare Xtal 4
	Declare Watchdog = OFF
	Declare FSR_CONTEXT_SAVE = On
   'Remarks    On

   Declare     LCD_DTPin              PORTC.0
   Declare     LCD_RSPin              PORTD.0
   Declare     LCD_ENPin              PORTD.1
   Declare LCD_Lines          2
   Declare LCD_Interface       4

	Hserial_Baud = 4800
	Hserial_RCSTA = %10010000
	Hserial_TXSTA = %00100100
	Hserial_Clear = On

	Declare Serial_Data 8
	'Symbol 84 = 84
	'Symbol 188 = 188

	Declare Adin_Res        10
   Declare Adin_Tad    32_FOSC
   Declare Adin_Stime  50

Dim ctr As Byte, alertCtr As Byte, UTC As Byte
Dim latWhole As Word, latDec As Word, latN As Float
Dim latI As Byte
Dim longWhole As Word, longDec As Word, longN As Float
Dim longI As Byte
Dim pfi As Byte
Dim RQCtr As Byte, smsFlag As Byte
Dim aRead1 As Word, aRead2 As Word, aRead3 As Word
Dim sendSelect As Byte, readCtr As Byte
Dim trash[20] As Byte

Dim sType As Byte

ADCON1=$80
TRISA=$FF
```

```
TRISB=$7E
TRISC=$A0
TRISD=$A8
TRISE=$07

DelayMS 500

Cls
Print At; 1, 1, "LCD OK"

'gosub hwdiagnostic
'GoSub gpsDiagnostic

PORTB 0.7 = 0
readCtr = 0
PORTB 0# = 0

DelayMS 3000

PORTB 0# = 1
DelayMS 2500
PORTB 0# = 0

DelayMS 2000


Cls
Print At; 1, 1, "INITIALIZING"
Print At; 2, 1, "DEVICE..."

DelayMS 10000

SerOut PORTD.4 , 84,["DIR",13]
DelayMS 3000
SerOut PORTD.4 , 84,["DIR",13]
DelayMS 3000

SerOut PORTD.4 , 84,[13]
SerIn PORTD.5 , 84, 2000, DRV_ERROR, [Wait(">")]
GoTo PROG_MAIN
DRV_ERROR:
            Cls
      Print At; 1, 1, "USB SOURCE"
      Print At; 2, 1, "MISSING."
```

```
        While 1 = 1
              Wend

DelayMS 5000

PROG_MAIN:

Cls

Print At; 1, 1, "GSM:Initializing"

SerOut PORTD.6, 84, ["A",13]

DelayMS 2000


   SerOut PORTD.6,84,["AT",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84, ["AT+CIURC=0",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   'HSerOut ["AT+CNMI=2,0,0,0,0",13]
   SerOut PORTD.6,84,["AT+CNMI=3,1,0,0,0",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84,["AT+CFUN=1",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84,["AT+CMGF=1",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84, ["AT+CMEE=0",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84,["AT+CSDH=0",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250
   SerOut PORTD.6,84,["ATE1",13]
   SerIn PORTD.7,84,1500,sms_init_fail,[Wait("OK")]
   DelayMS 250

Cls
Print At; 1, 1, "GSM: Init OK"
```

```
DelayMS 2000




Cls

Print At; 1, 1, "GPS:Initializing"

pfi = "0"

While 1 = 1

        HSerIn [Wait("$GPGGA,"), Wait(","),Dec4 latWhole, Dec5 latDec, latI,
Wait(","), Dec5 longWhole, Dec5 longDec ,longI,Wait(","),pfi]

     Print At; 2, 1, "PFI:", pfi

     If pfi <> "0" Then
         Break
     End If

Wend

Cls
Print At; 1, 1, "GPS: Init OK"

DelayMS 2000

Cls

Print At; 1, 1, "X:0000 | Y:0000"
Print At; 2, 1, "SPD: 000 Kph"

While 1 = 1

         aRead1=ADIn 0

         DelayUS 50

      aRead2=ADIn 1
```

```
    DelayUS 50

    aRead3=ADIn 2

    DelayUS 50

    aRead3 = aRead3 / 5

      Print At; 1, 3, Dec4; aRead1
  Print At; 1, 12, Dec4; aRead2
  Print At; 2, 6, Dec3; aRead3

If aRead1 > 700 Then
   sType = 2
         GoSub sendAlert
ElseIf aRead1 < 300 Then
      sType = 2
                GoSub sendAlert
    End If


    If aRead2 > 700 Then
      sType = 2
   GoSub sendAlert
ElseIf aRead2 < 300 Then
   sType = 2
   GoSub sendAlert
    End If

    If readCtr < 10 Then

         readCtr = readCtr + 1

    Else

   sType = 1
         GoSub sendAlert
         readCtr = 0

    End If

DelayMS 1000

Wend
```

```
smsSend:

RQCtr = 1

PORTB 0.7 = 1
DelayMS 3000
PORTB 0.7 = 0

startSending:

SerOut PORTD.6 , 84,  ["AT",13]

DelayMS 1000

SerOut PORTD.6 , 84,  ["AT",13]

DelayMS 1000

        SerOut PORTD.6 , 84,  ["AT+CMGS=",34,"09063460969",34,13]

DelayMS 1000

Select Case sType

   Case 1

       SerOut PORTD.6 , 84,  ["COORD:",latI,": ",Dec4 latN,", ",longI, ": ", Dec4
longN,32,"OK"]

   Case 2

       SerOut PORTD.6 , 84,  ["ACCIDENT:",latI,": ",Dec4 latN,", ",longI, ": ",
Dec4 longN,32,"OK"]

EndSelect



DelayMS 1000

SerOut PORTD.6 , 84,  [26]

DelayMS 5000
```

```
'If RQCtr>=1 Then

'   GoTo smsOut

'Else
'       RQCtr=RQCtr+1
'       GoTo startSending

'EndIf

smsOut:

DelayMS 1000

Return


sendAlert:

                Cls

                Select Case sType

                    Case 1

                        Print At; 1, 1, "UPDATING STATUS.."

                    Case 2

                        Print At; 1, 1, "SENDING ALERT.."

                EndSelect


          sendSelect = 1
                GoSub WriteData
                GoSub smsSend

                If sType = 2 Then

                 Cls
                 Print At; 1, 1, "SYSTEM LOCKDOWN"
```

```
            Print At; 2, 1, "VEHICULAR ACCIDENT"
            Print At; 2, 1, "HAS OCCURED."


            While 1 = 1
            Wend

           End If


Return

WriteData:

           HSerIn [Wait("$GPGGA,"),UTC, Wait(","), Dec4 latWhole, Dec5
latDec, latI, Wait(","), Dec5 longWhole, Dec5 longDec ,longI,Wait(","),pfi]

           Cls
           Print At; 1, 1, latI, ": ", Dec4; latWhole, ".", Dec4; latDec
           Print At; 2, 1, longI, ": ", Dec5; longWhole, ".", Dec4; longDec


           latN=latWhole//100

           latN = latN + latDec / 10000

           latN = latN / 60

           latWhole = latWhole / 100

           latN = latWhole + latN


           longN=longWhole//100

           longN = longN + longDec / 10000

           longN = longN / 60

           longWhole = longWhole / 100

           longN = longWhole + longN
```

```
SerOut PORTD.4 , 84,[13]
SerIn PORTD.5 , 84, 1000, DRV_ERROR, [Wait(">")]

SerOut PORTD.4 , 84, ["IPA",13]
SerIn PORTD.5 , 84, [Wait(">")]
SerOut PORTD.4 , 84,["OPW LOG.TXT",13]
SerIn PORTD.5 , 84, [Wait(">")]
SerOut PORTD.4 , 84,["WRF 85",13]

SerOut PORTD.4 , 84,["TILT:",13,10]
SerOut PORTD.4 , 84,[Dec4 aRead1," - X",13,10]
SerOut PORTD.4 , 84,[Dec4 aRead2," - Y",13,10]
SerOut PORTD.4 , 84,["SPEED:",13,10]
SerOut PORTD.4 , 84,[Dec4 aRead3," kph",13,10]
SerOut PORTD.4 , 84,["LOCATION:",13,10]

If latN < 10 Then
  SerOut PORTD.4 , 84,[latI,",0",Dec4 latN,13,10]
Else
  SerOut PORTD.4 , 84,[latI,",",Dec4 latN,13,10]
End If

If longN < 10 Then
  SerOut PORTD.4 , 84,[longI,",00",Dec4 longN,13,10]
ElseIf longN < 100 Then
  SerOut PORTD.4 , 84,[longI,",0",Dec4 longN,13,10]
Else
  SerOut PORTD.4 , 84,[longI,",",Dec4 longN,13,10]
Else

End If


SerOut PORTD.4 , 84,["-==-",13,10]
SerIn PORTD.5 , 84, [Wait(">")]
SerOut PORTD.4 , 84, ["CLF LOG.TXT",13]
SerIn PORTD.5 , 84, [Wait(">")]

            Return


sms_init_fail:

   Cls
```

```
    Print At; 1, 1, "INITIALIZATION"
    Print At; 2, 1, "FAILURE."

    While 1 = 1
    Wend

Return

hwDiagnostic:

Cls

Print At; 1, 1, "X:0000 | Y:0000"
Print At; 2, 1, "SPD: 000 Kph"

While 1 = 1

            Print At; 1, 3, Dec4; aRead1
        Print At; 1, 12, Dec4; aRead2
        Print At; 2, 6, Dec3; aRead3


          aRead1=ADIn 0

          DelayUS 50

       aRead2=ADIn 1

          DelayUS 50

          aRead3=ADIn 2

          DelayUS 50

          aRead3 = aRead3 / 5


       DelayMS 1000

Wend


Return
```

```
gpsDiagnostic:

Cls

Print At; 1, 1, "GPS Monitor"

pfi = "0"

readCtr = 0

trash [19] = 0

While 1 = 1

        HSerIn [Wait("$GPGGA,"), Wait(","),
Wait(","),Wait(","),Wait(","),Wait(","),pfi]
    'HSerIn[Str trash\19]

    'serin portc.5,188,[Wait("$GPGGA,"), Wait(","),
Wait(","),Wait(","),Wait(","),Wait(","),pfi]
    'SerIn PORTC.5,188,[readCtr]
    'SerOut PORTC.4,188,[Dec pfi,13]
    Inc readCtr

    Print At; 2, 1, "PFI:", pfi
    'Print At 2,1,readCtr
    Print At; 3, 1, "TRACK:", Dec3; readCtr


    If pfi <> "0" Then

        Print At; 4, 1, "SIGNAL OK!"
        While 1 = 1
        Wend
    End If

Wend


Return

End
```

For Server:

ModConnection

```
Global AdoConn As ADODB.Connection
Global RsTemp As ADODB.Recordset
Global Rs As ADODB.Recordset
Public strComNo As String
Public sDateToday As String
Public sChoiceNo

Public Sub ConnectDatabase()
Set AdoConn = New ADODB.Connection
AdoConn.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=" & App.Path &
"\Database\GPSLogs.mdb;Persist Security Info=False;Jet OLEDB:Database
Password=pokemon"
'Com No Port No. Default 1 For pc desktop
strComNo = "4"    'GLOBE TATTOO PORT NO FOR SMS , CHANGE HERE!
sDateToday = Format$(Now, "mm/dd/yyyy")
End Sub

Public Sub Wait(dwDuration As Long) 'delay
    Dim dblStart As Double, dblEnd As Double, dblNow As Double
    dblStart = Timer
    dblEnd = Timer + (dwDuration / 1000)
    Do
        dblNow = Timer
        DoEvents
    Loop Until dblNow < dblStart Or dblNow > dblEnd
End Sub
```

ModfrmMain

```
Dim sPacketData As String
Dim strAddress As String
Dim strModeStatus, YAxis, XAxis As String
Dim sLatitude, sLongitude As String
Dim slatDir, sLongDir, sXYAxis As String
Dim sGPMRC As String
Dim sGPGGA As String
Dim sDegrees, sMin, sSecs, secs
Dim lst As ListItem
Dim X, sID
```

```
Dim strdummy As String
Dim smsdata As String

Private Declare Sub Sleep Lib "kernel32" (ByVal dwMilliseconds As Long)
Option Compare Text
Option Explicit

Private Sub cmdQuit_Click()
On Error Resume Next
If MsgBox("Quit Application?", vbYesNo + vbQuestion, "REMOVE") = vbYes Then
   MSComm1.PortOpen = False
   End
End If
End Sub

Private Sub cmdSaveInfo_Click()
If txtSimNo.Text <> "" And txtRegistrationNo.Text <> "" And txtPlateNo.Text
<> "" Then
 If MsgBox("Save This Information/Data", vbYesNo + vbQuestion, "Save Data")
= vbYes Then
  Set Rs = New ADODB.Recordset
  Rs.Open "Select * From tblInformation", AdoConn, 1, 2
  If Rs.RecordCount > 0 Then
     Rs("RegistrationNo") = txtRegistrationNo.Text
     Rs("PlateNo") = txtPlateNo.Text
     Rs("SimCard") = txtSimNo.Text
     Rs.Update
  Else
     Rs.AddNew
     Rs("RegistrationNo") = txtRegistrationNo.Text
     Rs("PlateNo") = txtPlateNo.Text
     Rs("SimCard") = txtSimNo.Text
     Rs.Update
  End If
    Set Rs = Nothing
  End If
End If
End Sub

Private Sub LoadInformation()
Set Rs = New ADODB.Recordset
  Rs.Open "Select * From tblInformation", AdoConn, 1, 2
  If Rs.RecordCount > 0 Then
     txtRegistrationNo.Text = Rs("RegistrationNo")
```

```
    txtPlateNo.Text = Rs("PlateNo")
    txtSimNo.Text = Rs("SimCard")
    Rs.Update
  End If
   Set Rs = Nothing
End Sub

Private Sub cmdViewLoc_Click()
'strAddress = "http://maps.google.com/maps/api/staticmap?center=" &
txtGeoLat.Text & "," & txtGeoLong.Text &
"&zoom=14&size=400x400&maptype=map&sensor=true"
'strAddress =
"http://maps.google.com/maps/api/staticmap?center=14.653611,12.084167&zoo
m=14&size=400x400&maptype=map&sensor=true"
strAddress = "http://www.8051projects.info/maps.asp?lat=" & txtGeoLat.Text &
"&lon=" & txtGeoLong.Text
If txtID.Text <> "" And txtGeoLat.Text <> "" And txtGeoLong.Text <> "" Then
  WebBrowser1.Navigate strAddress
End If
End Sub

Private Sub ProcessParsing()
MSComm1.PortOpen = False
If sChoiceNo = "0" Then
  Exit Sub
End If
If sChoiceNo = "1" Then
  'LATITUDE
  sLatitude = Mid$(strdummy, 1, InStrRev(strdummy, ","))
  slatDir = Mid$(sLatitude, 7, 1)
  sLatitude = Trim$(Replace$(sLatitude, "COORD:N:", ""))
  sLatitude = Replace(sLatitude, ",", "")
  txtLatitudeDec.Text = sLatitude
  txt_NS.Text = slatDir
  'LONGTITUDE
  sLongitude = Mid$(strdummy, InStr(strdummy, ","))
  sLongDir = Mid$(sLongitude, 3, 1)
  sLongitude = Trim(Replace$(sLongitude, ", E:", ""))
  sLongitude = Replace(Trim$(sLongitude), vbCrLf, "")
  sLongitude = Replace(Trim$(sLongitude), " ", "")
  txtLongitudeDec.Text = sLongitude
  txt_WE.Text = sLongDir
'X Y ZERO VALUE
  XAxis = "0"
```

```
YAxis = "0"
   strModeStatus = "LOCATION"
   lblDegressLatLong.Caption = "TRANSMISSION RECEIVED!"
   Wait (3000)
   lblDegressLatLong.Caption = ""
   ret = sndPlaySound(App.Path & "\sound\alert.wav", SND_LOOP)
ElseIf sChoiceNo = "2" Then
   'LATITUDE
   sLatitude = Mid$(strdummy, 1, InStrRev(strdummy, ","))
   slatDir = Mid$(sLatitude, 10, 1)
   sLatitude = Trim$(Replace$(sLatitude, "ACCIDENT:N:", ""))
   sLatitude = Replace(sLatitude, ",", "")
   txtLatitudeDec.Text = sLatitude
   txt_NS.Text = slatDir
   'LONGTITUDE
   sLongitude = Mid$(strdummy, InStr(strdummy, ","))
   sLongDir = Mid$(sLongitude, 1, 3)
   sLongDir = Replace$(sLongDir, ",", "")
   sLongDir = Replace$(sLongDir, " ", "")
   sLongitude = Mid$(sLongitude, InStr(sLongitude, ":"))
   sLongitude = Replace$(sLongitude, ":", "")
   sLongitude = Trim$(Replace$(sLongitude, " ", ""))
   txtLongitudeDec.Text = sLongitude
   txt_WE.Text = sLongDir
   strModeStatus = "ACCIDENT"
   ret = sndPlaySound(App.Path & "\sound\alert.wav", SND_LOOP)
   lblDegressLatLong.Caption = "ALERT ACCIDENT OCCURED!"
   'MsgBox "ALERT!!! ACCIDENT OCCURED!", vbExclamation, "Message"
   Wait (3000)
   lblDegressLatLong.Caption = ""
End If
strdummy = ""
smsdata = ""
 X = Val(X) + 1
'get counter last ID , No.
Call GetLastID
'save GPS Logs
Call SaveGPSLogs
'Increment update IDcounter
Call UpdateIDCounter
'Load ListView GPS Logs
Call PopulateListView
Wait (1000)
'LOAD MAP
```

```
strAddress = "http://www.8051projects.info/maps.asp?lat=" &
txtLatitudeDec.Text & "&lon=" & txtLongitudeDec.Text
WebBrowser1.Navigate strAddress
MSComm1.PortOpen = True
strdummy = ""
smsdata = ""
End Sub

Private Sub PopulateListView()
On Error Resume Next
ListView1.ListItems.Clear
Set Rs = New ADODB.Recordset
Rs.Open "Select * From tblGPSLogs Order By ID Asc", AdoConn, 1, 2
If Rs.RecordCount > 0 Then
    Do Until Rs.EOF
    Set lst = ListView1.ListItems.Add(, , Rs("ID"))
    lst.SubItems(1) = Rs("Latitude")
    lst.SubItems(2) = Rs("Longitude")
    lst.SubItems(3) = Rs("XAxis")
    lst.SubItems(4) = Rs("YAxis")
    lst.SubItems(5) = Rs("ModeStatus")
    Rs.MoveNext
    Loop
Else
End If
 Set Rs = Nothing
End Sub

Private Sub Form_Load()
Call ConnectDatabase
X = 0
sID = 0
'sGPMRC =
"$GPRMC,225446,A,4916.45,N,12311.12,W,000.5,054.7,191194,020.3,E*68"
'sGPGGA = "$GPGGA,123519,4807.038,N,01131.324,E,1,08,0.9,545.4,M,46.9,M,
, *42"
'Load ListView GPS Logs
Call PopulateListView
'Call LoadInformation
'Open Mscom
With MSComm1
.CommPort = strComNo
.InputLen = 0
.RThreshold = 1
```

```
If .PortOpen = False Then
   .PortOpen = True
    .Output = "AT" & Chr(13)
     Wait (1000)
    .Output = "AT" & Chr(13)
    Wait (1000)
    .Output = "AT+CMGF=1" & Chr(13)
     Wait (1000)
    .Output = "AT+CNMI=" & "1,2,0,0,0" & Chr(13)
     Wait (1000)
     MSComm1.InBufferCount = 0
     strdummy = ""
End If
WebBrowser1.Navigate2 "http://www.google.com"
End With
End Sub

Private Sub DecodeLattitude()
sLatitude = txtLatitudeDec
'Get seconds
sSecs = Mid$(sLatitude, InStr(sLatitude, "."))
sSecs = CDbl(sSecs)
secs = CDbl(sSecs) / 3600
'Get minutes
sMin = Mid$(sLatitude, InStrRev(sLatitude, "."))
sMin = Trim$(Replace$(sLatitude, sMin, ""))
sDegrees = sMin
If Len(sMin) = 4 Then
   sMin = Right$(sMin, 2)
ElseIf Len(sMin) > 4 Then
  sMin = Right$(sMin, 2)
End If
'Get Degrees
If Len(sDegrees) = 4 Then
   sDegrees = Left$(sDegrees, 2)
ElseIf Len(sDegrees) > 4 Then
   sDegrees = Left$(sDegrees, 3)
End If
'lblDegressLatLong.Caption = "LATITUDE:" & sDegrees & "° " & sMin & "' " &
sSecs & Chr(34)
'FORMULA CONVERTION TO DECIMAL VALUE FOR GEOCODE
'Degrees + (Minutes/60) + (Seconds/3600)
'txtGeoLat.Text = CInt(sDegrees) + (CDbl(sMin) / 60) + (CDbl(sSecs) / 3600)
txtGeoLat.Text = Val(sDegrees) + Val(sMin) / 60 + Val(sSecs) / 3600
```

```
txtGeoLat.Text = Format$(txtGeoLat.Text, "##.######")
End Sub

Private Sub DecodeLongitude()
sLongitude = txtLongitudeDec
'Get seconds
sSecs = Mid$(sLongitude, InStr(sLongitude, "."))
sSecs = CDbl(sSecs)
secs = CDbl(sSecs) / 3600
'Get minutes
sMin = Mid$(sLongitude, InStrRev(sLongitude, "."))
sMin = Trim$(Replace$(sLongitude, sMin, ""))
sDegrees = sMin
If Len(sMin) = 4 Then
   sMin = Right$(sMin, 2)
ElseIf Len(sMin) > 4 Then
  sMin = Right$(sMin, 2)
End If
'Get Degrees
If Len(sDegrees) = 4 Then
   sDegrees = Left$(sDegrees, 2)
ElseIf Len(sDegrees) > 4 Then
   sDegrees = Left$(sDegrees, 3)
End If
'lblDegressLatLong.Caption = "DEGREES: " & lblDegressLatLong.Caption & "
LONGITUDE:" & sDegrees & "° " & sMin & "' " & sSecs & Chr(34)
'FORMULA CONVERTION TO DECIMAL VALUE FOR GEOCODE
'Degrees + (Minutes/60) + (Seconds/3600)
'txtGeoLat.Text = CInt(sDegrees) + (CDbl(sMin) / 60) + (CDbl(sSecs) / 3600)
txtGeoLong.Text = Val(sDegrees) + Val(sMin) / 60 + Val(sSecs) / 3600
txtGeoLong.Text = Format$(txtGeoLong.Text, "##.######")
End Sub

Private Sub SaveGPSLogs()
Set Rs = New ADODB.Recordset
Rs.Open "Select * From tblGPSLogs", AdoConn, 1, 2
Rs.AddNew
Rs("ID") = sID
Rs("Latitude") = txtLatitudeDec.Text   'txtGeoLat.Text
Rs("Longitude") = txtLongitudeDec.Text 'txtGeoLong.Text
Rs("LogDate") = Format$(Now, "mm/dd/yyyy")
Rs("LogTime") = Format$(Now, "hh:mm AM/PM")
'Rs("Degrees") = lblDegressLatLong.Caption
Rs("XAxis") = XAxis
```

```
Rs("YAxis") = YAxis
Rs("ModeStatus") = strModeStatus
Rs.Update
Set Rs = Nothing
End Sub

Private Sub GetLastID()
Set Rs = New ADODB.Recordset
Rs.Open "Select * From tblLogsCounter", AdoConn, 1, 2
If Rs.RecordCount > 0 Then
   sID = Val(Rs("ID")) + 1
End If
  Set Rs = Nothing
End Sub

Private Sub UpdateIDCounter()
Set Rs = New ADODB.Recordset
Rs.Open "Select * From tblLogsCounter", AdoConn, 1, 2
If Rs.RecordCount > 0 Then
   Rs("ID") = sID
   Rs.Update
End If
   Set Rs = Nothing
End Sub

Private Sub ListView1_ItemClick(ByVal Item As MSComctlLib.ListItem)
txtID.Text = Item.Text
End Sub

Private Sub MSComm1_OnComm()
Select Case MSComm1.CommEvent
Case comEvReceive
      smsdata = smsdata & MSComm1.Input
      If InStr(smsdata, "COORD") And InStr(smsdata, "OK") Then
           strdummy = smsdata
           MSComm1.InBufferCount = 0
           strdummy = Mid$(strdummy, InStr(strdummy, "COORD"))
           strdummy = Trim$(Replace$(strdummy, "OK", ""))
           'lblPacket.Caption = lblPacket.Caption & strdummy
           lblPacket.Caption = "Packets Received:" & strdummy
           sChoiceNo = "1"
           Call ProcessParsing
     ElseIf InStr(smsdata, "ACCIDENT") And InStr(smsdata, "OK") Then
           strdummy = smsdata
```

```
            MSComm1.InBufferCount = 0
            strdummy = Mid$(strdummy, InStr(strdummy, "ACCIDENT"))
            strdummy = Trim$(Replace$(strdummy, "OK", ""))
            'lblPacket.Caption = lblPacket.Caption & strdummy
            lblPacket.Caption = "Packets Received:" & strdummy
             sChoiceNo = "2"
             Call ProcessParsing
          End If
End Select
    MSComm1.InBufferCount = 0
    strdummy = ""
    smsdata = ""
End Sub

Private Sub txtID_Change()
Set Rs = New ADODB.Recordset
Rs.Open "Select * From tblGPSLogs Where ID=" & txtID.Text & "", AdoConn, 1,
2
If Rs.RecordCount > 0 Then
   txtGeoLat.Text = Rs("Latitude")
   txtGeoLong.Text = Rs("Longitude")
   txtLogDate.Text = Rs("LogDate")
   txtLogTime.Text = Rs("LogTime")
   txtModeStatus.Text = Rs("ModeStatus")
   'lblDegressLatLong.Caption = Rs("Degrees")
End If
Set Rs = Nothing
End Sub
```

ModGPS

```
Public GPSDATA As String
Public RMC_STATUS As String
Public GGA_STATUS As String
Public NUM_SAT As String
Public DA_TE As String
Public TI_ME As String
Public LATITUDE As String
Public LONGITUDE As String
Public N_S As String
Public E_W As String
Public ALTITUDE As String
Public HEADING As String
```

```
Public SPEED As String
Public RMC_CHK_SUM As String
Public GGA_CHK_SUM As String
Public RMC_DATA(1 To 20) As String
Public GGA_DATA(1 To 20) As String
'in a form, put this
Dim Rs() As String
'if you have a string like tom="this is 'a test ' in order to'test'
Function PROCESS_RMC(RMC As String) As Boolean
Dim X As Integer
Dim CHK As String
   For X = 1 To 12
   DoEvents
      RMC_DATA(X) = sGetToken(RMC, X)
         If X = 12 Then
            RMC_DATA(X) = sGetToken(RMC, 2, "*")
         End If
         If X = 1 Then
            RMC_DATA(X) = Right(RMC_DATA(1), 5)
         End If
   Next X
   CHK = GetChecksum(RMC)
RMC_STATUS = RMC_DATA(3)
DA_TE = RMC_DATA(10)
TI_ME = RMC_DATA(2)
LATITUDE = RMC_DATA(4)
N_S = RMC_DATA(5)
LONGITUDE = RMC_DATA(6)
E_W = RMC_DATA(7)
HEADING = RMC_DATA(9)
SPEED = RMC_DATA(8)
RMC_CHK_SUM = RMC_DATA(12)
If RMC_CHK_SUM = CHK Then
   PROCESS_RMC = True
Else
   PROCESS_RMC = False
End If
End Function

Function PROCESS_GGA(GGA As String) As Boolean
Dim X As Integer
Dim CHK As String
   For X = 1 To 16
   DoEvents
```

```
        GGA_DATA(X) = sGetToken(GGA, X)
            If X = 16 Then
                GGA_DATA(X) = sGetToken(GGA, 2, "*")
            End If
            If X = 1 Then
                GGA_DATA(X) = Right(GGA_DATA(1), 5)
            End If
    Next X
    CHK = GetChecksum(GGA)
GGA_STATUS = GGA_DATA(7)
NUM_SAT = GGA_DATA(8)
ALTITUDE = GGA_DATA(10)
GGA_CHK_SUM = GGA_DATA(16)
If GGA_CHK_SUM = CHK Then
    PROCESS_GGA = True
Else
    PROCESS_GGA = False
End If
End Function

 Function GetChecksum(ByRef sInString As String) As String
  Dim lCurrent&, lLast&
  On Error Resume Next
   If Mid$(sInString, 1, 1) = "$" Then
    sInString = Mid$(sInString, 2)
  End If
   lLast& = Asc(Mid$(sInString, 1, 1))
   For lCurrent& = 2 To Len(sInString) - 3
    lLast& = lLast& Xor Asc(Mid$(sInString, lCurrent&, 1))
  Next
    GetChecksum = CStr(Hex(lLast&))
End Function
'
*****************************************************************
*****************
' Synopsis          Returns the Nth Token from sAllTokens delimited by sDelim
'
' Parameters
'
'   sAllTokens              (I) Required. The string containing all the tokens
'   iToken                  (I) Optional. The index of the token to return
'                           DEFAULT = 1
'   siDelim                 (I) Optional. The delimiter string that separates
'                           the tokens. DEFAULT = " "
```

```
' Description
'  For the following:
'    sAllTokens        iToken   sDelim  Returns       Notes
'   "William M Rawls"    1       " "     "William"      First word
'   "William M Rawls"    2       " "     "M"           Second word
'   "William M Rawls"    3       " "     "Rawls"        Third word
'   "William M Rawls"    4       " "     ""            No forth word
'   "William M Rawls"    0       " "     ""            Zeroth token is always empty
'   "William M Rawls"   -1       " "     ""            Negative tokesn always empty
'   "William M Rawls"    1       ""      ""            No delimiter ? Token empty
'
*************************************************************
*****************
Function sGetToken(ByVal sAllTokens As String, Optional ByVal iToken As
Integer = 1, Optional ByVal _
sDelim As String = ",") As String
   Static iCurTokenLocation As Long ' Character position of the first delimiter
string
   Static nDelim As Integer           ' Length of the delimiter string
   nDelim = Len(sDelim)
   If iToken < 1 Or nDelim < 1 Then
    ' Negative or zeroth token or empty delimiter strings mean an empty token
      Exit Function
   ElseIf iToken = 1 Then
    ' Quickly extract the first token
      iCurTokenLocation = InStr(sAllTokens, sDelim)
      If iCurTokenLocation > 1 Then
         sGetToken = Left(sAllTokens, iCurTokenLocation - 1)
      ElseIf iCurTokenLocation = 1 Then
         sGetToken = ""
      Else
         sGetToken = sAllTokens
      End If
      Exit Function
   Else
    ' Find the Nth token
      Do
         iCurTokenLocation = InStr(sAllTokens, sDelim)
         If iCurTokenLocation = 0 Then
            Exit Function
         Else
            sAllTokens = Mid(sAllTokens, iCurTokenLocation + nDelim)
         End If
         iToken = iToken - 1
```

```
      Loop Until iToken = 1
    ' Extract the Nth token (Which is the next token at this point)
      iCurTokenLocation = InStr(sAllTokens, sDelim)
      If iCurTokenLocation > 0 Then
        sGetToken = Left(sAllTokens, iCurTokenLocation - 1)
        Exit Function
      Else
        sGetToken = sAllTokens
        Exit Function
      End If
   End If
End Function

Function Delimiter(ByVal texte As String, ByVal delimiter1 As String, ByVal
delimiter2 As String) As String
Dim R1 As Integer
Dim R2 As Integer
Dim STT As String
Dim STP As String
Dim DDT As String
On Error Resume Next
DDT = texte   'VARIABLES
STT = delimiter1
STP = delimiter2

R1 = CInt(InStr(1, DDT, STT))
R2 = CInt(InStr(R1 + 1, DDT, STP))
Delimiter = Mid(DDT, CLng(R1), CLng(R2 - R1))
On Error GoTo 0
End Function
```

ModSound

```
Global ret As Long
Declare Function sndPlaySound Lib "winmm.dll" Alias "sndPlaySoundA" (ByVal
lpszSoundName As String, ByVal uFlags As Long) As Long

Public Const SND_ALIAS = &H10000     '  name is a WIN.INI [sounds] entry
Public Const SND_ASYNC = &H1         '  play asynchronously
Public Const SND_LOOP = &H8         '  loop the sound until next sndPlaySound
Public Const SND_NOWAIT = &H2000      '  don't wait if the driver is busy
Public Const SND_SYNC = &H0         '  play synchronously (default)
```

SAUDI GERMAN HOSPITAL (217 Beds)

WE CARE !

مجموعة مستشفيات السعودي الألماني- جدة
Saudi German Hospital - Jeddah

المستشفى السعودي الألماني (٢١٧ سرير)

نحن بعون الله نرعاكم !

Letter of Intent to Use

December 9, 2011

Engr. Ayra G. Panganiban
Faculty
Department of Computer Engineering
Mapua Institute of Technology
Intramuros, Manila

Dear Engr. Ayra G. Panganiban

Our company, Saudi German Hospital-Jeddah, with business address at Batterjee St., Al Zahraa District, Jeddah, Kingdom of Saudi Arabia, through this letter is signifying its intention to use the solution being proposed by the Computer Engineering students, **Delarmente, Christopher, Hinanay, Juris Lan H., Mendoza, Charisma Ann M., Tolosa, Myra A.**, of Mapua Institute of Technology. At present, the company need of a solution that will satisfy our need of monitoring and tracking of our company vehicles such as employee bus, company cars and ambulances. The proposed solution entitled "**Design of the GPS Tracking System for Monitoring Parametric Vehicular Measurements with accident notification"** was based on the aforementioned need presented to your students.

The company believes the solution your students will provide, will be of great help to our company's operation. We are looking forward for your approval of the said solution.

Dr. Mamoun Al-Najjar
Chief Executive Officer
ceo.jed@sghgroup.net

Telephone # +966-2-6829000 Ext. 5037, 5417
Cell Phone# +966-5-30466644

GPS TRACKING SYSTEM FOR MONITORING PARAMETRIC VEHICULAR MEASUREMENTS WITH ACCIDENT NOTIFICATION VIA SMS FOR SAUDI GERMAN HOSPITAL

Christopher T. Delarmente, Juris Lan H. Hinanay, Charisma Ann M. Mendoza, Myra A. Tolosa

School of Electrical, Electronics and Computer Engineering, Mapúa Institute of Technology
Muralla St., Intramuros, Manila, Philippines

Abstract - The Global Positioning System ha now become a popular and widely used tool in terms of the application of tracking a certain target and locating its position. The main objective of the design is to develop a monitoring device that shall record parametric developments of the vehicle during its time on the road, and shall be stored on the memory built on the car. The designed device consists of the microcontroller, the accelerometer, the VDIP module, the GSM module, and the GPS module. A windows GUI application shall be included that will serve as the medium for accessing the data and to view its contents including the location with the help of Google Maps. The designed device shall have an SMS alert feature that will be triggered once an accident has occurred. Assessment of the device showed that the device records data and alerts successfully in an acceptable timeframe, when the vehicle occurred in an accident such as tilting and sudden stops, albeit with issues regarding GPS signal strength on bad weather conditions. From the results, the designers concluded that a device capable of recording vehicle activities and alerting using SMS is successfully developed.

I. DESIGN BACKGROUND AND INTRODUCTION

Location is a very important piece of information. Knowing one's location helps know a person/object's exact place of setting. When the researchers talk about location, they are more particular with the place in which the target is, at the same time they are curious on the speed and direction the target is going in that specific location and more importantly where is that location.

Anyone who has a vehicle of any kind will find that there are plenty of reasons for wanting a GPS based tracking system installed. The tracking systems available to consumers are obviously less sophisticated than what a fleet manager would use but one may still be amazed at what they can do. If someone is concerned about their car, auto, van or truck being stolen then if it was tracked they would now know where it was if it went missing. A parent may want to install one in the car that their kids use so they can monitor not only where they go, and how long they stay there but also how fast they go. Recent surveys have suggested that the driving speed of their children is the major concern of parents when their kids are behind the wheel of a car or even if someone else is driving. If their kids are in the car they could be at risk. Using a tracking system could even help a parent to teach their kids to drive responsibly. If they are employers then they may want to monitor where their company cars and when their employees are driving them to ensure that they don't incur extra costs due to unofficial non-company travel or other non-business purposes. These are the common scenarios that can happen when someone wants to know what exactly is happening with the vehicles that they use, and most certainly want to know when, how and why it was used.

A. Statement of the Problem

Common knowledge is that most business company with delivery services often have complaints about on delivery time problems with their clients, or most oil companies sometimes, more often than not, that they might have someone delivers oil tanker's illegal transactions without their knowledge, or mostly on Bank Company that runs their own Armored Car. In this situation the owner is unaware whether the driver of the armored car is trustworthy of delivering their money to their respective patrons, or maybe there are some ordinary public vehicles that travel in isolated places in which help is out of reach in case an accident happens and information about accidents is slow or sometimes never reaches to the public that an accident has occurred, and another problem is the overwhelming car napping in the current setting, here when a vehicle is stolen it is sometimes hard to track down the vehicle at once.

Knowing where someone is different from knowing what they are doing in such place. Thus, most industries and owner of vehicles are very particular on where their cars are traveling. The illegal use of their vehicle sometime enters their mind and therefore wonders whether the utilization of their vehicles has already involved in an illegal transactions other than their own business. Another usefulness of the location is that when accidents occur, the exact place of the accident can easily be accessed by knowing the shortest route to the accident site. This is where the application of the GPS comes in. Knowing the location of the vehicle can help deduce these doings, plus will help observe the vehicle's parametric standing.

B. Objectives of the Design

The objective of the design is to be able to monitor the vehicle's parametric data, such as the direction, location and speed. By doing so, the driver or owner of the vehicle is fully aware of how he is utilizing his car. Another objective of the design mainly focuses on recording and monitoring the parametric data, which are stated above, before and after an accident occurs. The recorded data will be stored as a text file named "log" in the USB drive mounted on the device. With this information, the users can simply analyze why the vehicle had ended up in an accident, from here they can conclude whether the vehicle had sped up or had simply gone out of course. Another objective of the design is to be able to send early alert notification to the server when an accident happens. Most accidents that happen in isolated areas eventually receive help a few hours later; but with the design, the SMS feature is triggered at once and sends the message in order to get untimely help from those who are near the accident site. Another objective is that by monitoring frequently the places of which the vehicle has gone; the user is able to get the analysis of the place. This simply answers the question why is the vehicle in that place when it is not supposed to be there.

C. Design Constraints

GPS system is limited to areas that are known and on-land only; when the vehicle goes under a tunnel the GPS could no longer detect it. The USB device mounted into the vehicles records the data of the vehicle's location, speed, and direction thus the capacity of the USB is depended on it. When the capacity of the USB's storage is low the amount of recorded activity varies with it. The SMS feature is also dependent on both the Signal and the Provider. When the accident occurred in an area that has absolutely no signal, the SMS feature won't be able to send the message to the server.

II. REVIEW OF RELATED LITERATURE AND STUDIES

The significant power of the GPS technology had become a huge aspect in society's monitoring systems. Knowing one's location is a very important factor in terms of observing a specific target. When this information is obtained, tracking it down is easy as drawing a line from one point to another. By tracking down the point from which the target had come from, up to the point of which it shall stop, is an easy access since the Global Positioning Satellite System makes this easier for observers to monitor the vehicles course.

Global Positioning System

GPS or Global Positioning System provides two levels of service, Standard Positioning Service (SPS) and Precise Positioning Service (PPS). The SPS is a

positioning and timing service that is available to all GPS users on a continuous worldwide basis. SPS is provided on the L1 frequency (1575.42), which contains the navigation data message and the SPS code signals. The PPS is a highly accurate military positioning, velocity and timing service which is available to users authorized by the Department of Defense**.** Since its inception in 1978, GPS has fast become the most popular satellite aided navigation system used worldwide. Many industries, such as civil aviation, shipping and agriculture, have become quite dependent on this service.

GPS or Global Positioning System as according to the article of Jay Warrior, Eric McHenry, and Kenneth McGee, “They Know Where You Are” written in January 2003, that the first development of the tracking system was used for military purposes. The constellation of U.S. military satellites that are used to guide everything from bombs to ordinary passenger cars, to monitoring assaults had made a huge development for national security against terrorist attacks. In Europe, the use of the GPS played a huge role in terms of cellular communication technologies. The technology depends on a form of triangulation: it requires at least three cellular base stations to receive a signal from the wireless handset, and then computes the location from the differences in arrival times of the three signals.

Through this technology, the military is able to counter these attacks by using the enemies’ location against them. For communication, the benefits of location technology aren’t limited to subscribers—it will also help wireless carriers improve their systems, by making every enabled handset an instrumentation probe. Signals played an important part since they are called “hints”, as according to the article, these hints suggest the GPS satellites that will give the quickest fix on the position. These hints are particularly necessary when the phone is indoor or the enemy is underground and GPS reception is more limited.

The concept of the GPS mainly applies to monitoring people and knowing their locations. In the paper Design and Implementation of a Mobile Devices-based Real-time Location Tracking by Hyo-Haeng Lee, In-Kwon Park, and Kwang-Seok Hong, this paper proposes a real-time location tracking system using a GPS module for different mobile devices and multiple users. It focuses on the management and observation of a majority of people can be foretold. The development was made so the user may acquire and manage location information of specified subjects, who require individual care in real-time. Such users include those requiting specific protective measures, children, and the elderly. In applications to vehicle, this is also the same, the researchers are to use this basic concept and apply in cars so as to keep track of the vehicle n terms of security and reliability.

Based on research, navigation enables a user to process his current location based on GPS data and travel to his desired location, also based on accurate GPS data. Any user with a working GPS receiver can navigate to a particular destination, whether traveling on foot, by automobile, by airplane or by ship. Time is the fourth dimension that GPS is set up to provide, by synchronizing each GPS receiver to the GPS satellites to provide accurate time to the user.

Global System for Mobile Communications (GSM) and SMS services

Mobile services are widely used today. In the paperDesign and Implementation of a Mobile Devices-based Real-time Location Tracking by Hyo-Haeng Lee, In-Kwon Park, and Kwang-Seok Hong, the use of mobile is to track and to identify the location of objects in real time. They may use simple, inexpensive nodes (badges/tags) attached to or embedded in objects and devices (readers) that receive the wireless signals from these tags to determine their location. One of the mobile services that can be accessed is the GPS feature. The paper proposes a real-time location tracking system using a GPS module for different mobile devices. Several users may be required to manage and to observe most of the subjects (people) being monitored. Another mobile feature adopted is the GIS that has been implemented on many mobile devices. With the widespread adoption of GPS, GIS has been used to capture and to integrate data in the field. GIS APIs are designed to manage GIS data for delivery to a web browser client from a GIS server. They are accessed with a commonly used scripting language such as VBA or JavaScript.

In another paper, Design and Implementation of Real Time Vehicle Tracking System by Muhammad Adnan Elahi, Yasir Arfat Malkani2, and Muhammad Fraz, written and proposed in 2007, After collecting positioning data, it is transmitted using some kind of telemetry or wireless communications systems. GSM is the most common used service for this purpose.

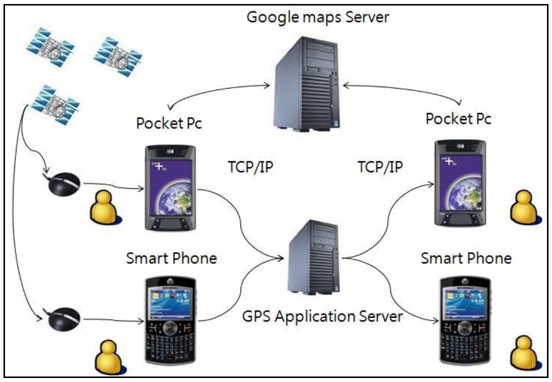


Figure 2.1 Architecture of the mobile device based real-time tracking system

The figure shown above, mainly explains how the GSM works with the GPS and GIS application. The user receives desired information from the mobile device, mounted with a GPS receiver, to access the location based service. When the client transfers longitude and latitude received from the GPS receiver to the GPS application server via TCP/IP, other mobile client users convey location information data, accessing the GPS application server.

As reference to the study, the researchers shall require a GPS application server in mobile devices for wireless communication for the SMS alert system. Based from the reference, if a mobile device user shall acquire the GPS location information when the server had sent it, the acquired location information is transferred to the GPS application server after transforming the coordinates. Then other mobile device users access the multi-user real-time location information from the GPS application server. The use of the information shall be used for the purpose of the accident alert system.

Geographic Information System

A Geographic Information System (GIS) is any system to capture, store, analyze and manage data and associated attributes that are spatially referenced to Earth and Location Based Services (LBS). GIS are information services accessible via mobile devices through the mobile network that utilize the location of the mobile device. GIS analysis software takes GIS data and overlays or otherwise combines it so that the data can be visually analyzed. It can output a detailed map, image or movie used to communicate an idea or concept with respect to a region of interest. This is usually employed by persons who are trained in cartography, geography or a GIS professional, as this class of application is complex and takes time to master. The software transforms raster and vector data sometimes of differing data type, grid or reference systems, into one coherent image. It can also analyze changes over time within a region.

The application of GIS in the research is to determine the tracking route of a targeted vehicle. The research shall use the concept of the GIS as reference for the software development only. Other software for the vehicle monitoring and tracking shall be developed further during the research.

Vehicular Tracking

According to a review, using GPS Tracking for Vehicle and Personnel Management in Industries on The Rise by Vaishnavikna Pathak, those industries which are involved in transportation, logistics, manufacturing, etc. have a number of vehicles that are on the move or transport goods to the different points of sale. Even, they would require the raw materials to be brought in from the distant areas, and they have to be brought in perfect time. It is also required that the vehicles in the fleet are to be monitored regularly about their reach and return on time, so that the next travel plan and consignment can be delivered. Personnel tracking help in reducing the labor and unnecessary haggling with clients by remaining in the uncertain cloud. The GPS tracking device that is fitted in these vehicles can easily convey the location and the approximate arrival time.

In another research paper, Design and Implementation of Real Time Vehicle Tracking System by Muhammad Adnan Elahi, Yasir Arfat Malkani2, and Muhammad Fraz, written and proposed in 2007, tracking was to serve the main purpose of navigation for location-based applications. Real time vehicle tracking system is successfully implemented using SMS of GSM network, and GPRS as transport channel to achieve the desired properties of Automatic Vehicle Location (AVL) system. The paper covers the hardware and software design of devices developed to determine and transmit the vehicle's information, such as its location, to the remote Tracking Server. Tracking Systems aid in determining the geographic positioning

information of vehicles, once collected it will then transmit it to a remotely located server.

In the same paper, the vehicle's location is determined using GPS, while the transmission mechanism can be satellite, terrestrial radio or cellular connection from the vehicle to a radio receiver, satellite or nearby cell tower. There may also exist some other alternatives for determining the location in the environments where GPS signal strength is poor, such as dead reckoning, i.e. inertial navigation, active RFID systems or cooperative RTLS systems.

In the IEEE paper, GPS Based Marine Vessel Tracking Device by Glenford A. McFarlane and Joseph Skobla, satellite navigation has started to expand into other areas such as recreation, security, and emergency response. Without any reservation, this form of position acquisition is here to stay and can only get better. In the paper, the goal of the project is to provide GPS tracking solution for fishing boats. The processing unit is equipped with two communication ports one dedicated for the GPS receiver and the second for radio link.

Such monitoring of the vehicle's time is depended on the vehicle's activity, whether the target had slowed down or sped up, or has entered a traffic area or just simply halted momentarily in an isolated area. This is where the study comes in; monitoring the vehicles' events helps utilize this information in order to maximize the industries demands and requirement in terms of delivering trade and monitoring.

Vehicular Monitoring

In the proposed paper, A New Approach of Automobile Localization System Using GPS and GSM/GPRS Transmission, by Ioan Lita, Ion Bogdan Cioc, and Daniel Alexandru Visan started in 2006; the paper basically covers the whole concept of our research on monitoring vehicular activity. The same concept of tracking and monitoring the vehicle was merely developed for the reasons useful for adolescent drivers watching by their parents, in case of employees supervising, etc. The proposed application represents a low cost automotive localization system using GPS and GSM-SMS services for car localization. Optional, other parameters can be transmitted to inform the owner about car parameters like engine state, speed, speed limit exceeding or delimited area leaving, or giving car commands like engine stopping in theft situation, etc. This system can be connected to a PC or laptop for settings or for use as navigation system. Using the GPRS transmission, the presented system can realize car tracking function, together with automobile parameters and engine monitoring and alarm event signaling.

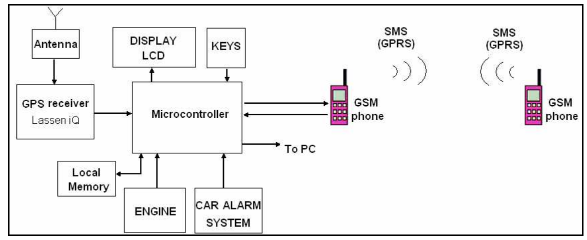


Figure 2.2 Block diagram of the complex automobile system with SMS / GPRS transmission

In this paper, the monitoring of the vehicle is an optional action in which every parameter of the vehicle is sent to the mobile of the owner of the car. This feature of the proposal is impractical since the storage of the cell phone isn't large enough to accommodate the data, and impractical since it will annoyingly keep alerting the owner of his car's activity, like when the engine starts, speed limit and area informative. This sort of application is only useful for car theft in which the request to monitor the car is only made possible when the owner is away from the vehicle and that the owner had activated the request for monitoring through the SMS feature. This serves as the alerting system, but the localization of where the car might have gone will be difficult to find, even with the use of the tracking system. As a recommendation from the paper, further development of complex car monitoring and control system is still being studied. No actual development of the hardware was made, but the concept of the proposed system is shown in Figure1.1 The proposed solution can be used in other types of application, where the information needed is requested rarely and at irregular period of time.

Wireless Sensor Devices and Communication System

In the IEEE article, On the Architecture of Vehicle Tracking System Using Wireless Sensor Devices by Aravind .K. G, Tapas Chakravarty, M. Girish Chandra, and P. Balamuralidhar, the whole concept of tracking the vehicle down mainly focuses on the

networking GPS of the vehicle itself through the use of low cost, effective implementation as in contrast to the existing high cost tracking systems. The whole idea of tracking the vehicle is based on Gateway nodes. These wireless nodes are addressed by the registration number of the vehicles which are unique. The GW nodes which are commonly known as road-side units (RSUs) are installed on the buildings, lamp posts etc. These nodes are connected to the underlying wired infrastructure (internet) to receive query from the central server and reply back with the necessary information. As the location of a vehicle to be tracked is unknown, broadcasting is chosen as mean of communication. This system too has many other applications like reporting accidents on the roads, so that nearest ambulance services may reach the spot thereby saving more lives.

Another article, Development of Tracking Train Detection Device (COMBAT)by Using Wireless Communication by Noriyuki Nishibori, and Tatsuya Sasaki, COMBAT stands for Computer and Microwave Balise Aided Train detection. According to the article, The COMBAT comprises a microwave Balise (interrogator, wayside responder and on-board responder) and a processing unit. The interrogator and wayside responder are installed close to the entering signal and starting signal, holding the trackline in between. This system detects the existence and direction of the train at the detecting point (microwave Balise installation site).

The main problem of such application is that the information of tracking is being bounced from one GW node to another, this way of tracking a vehicle is very impractical due to many interferences that might occur on the location of the GW nodes. Another problem seen is that the location of the GW nodes itself which are mounted into posts and buildings, the location of these nodes is not that reliable because in due time these posts and building might no longer be able to support the nodes, and might as well distort the signal which can eventually occur into data loss. In the COMBAT application, though the tracking of the train is somewhat convenient, the problem seen here is that the train follows a provided route for them, thus the tracking of the train is irrelevant, and tracking system is no longer applicable here.

Vehicular Routing Problem

The Vehicle Routing Problem (VRP) can be The Vehicle Routing Problem (VRP) can be described as the problem of designing optimal delivery or collection routes from one or several depots to a number of geographically scattered cities or customers, subject to side constraints. Vehicle Routing Problem or VRP is the fundamental problem in the research fields of transportation; various types of VRP are studied to determine the optimal route under various constraints of locations, distance, time window and activities. In order to improve the route waste collection a certain type of algorithm is proposed. But it is difficult to straightly apply one case result to other cases, because the different constraints cause other difficult problems. Such problem occurrences in indeterminate since traffic in a location is unexpected, accidents happens sudden making is one factor for finding routes that makes a short route become a long way of travel. These factors are out of hand for the user of the vehicle so it shall be included in the limitation of the research. Versions of the problem and a wide variety of exact and approximate algorithms have been proposed for its solution. Exact algorithms can only solve relatively small problems, but a number of approximate algorithms have proved very satisfactory. However, several promising avenues of research deserve more attention, such as search methods.

Automatic Vehicle Location (AVL)

This Automatic Vehicle Location System (AVL) is a complete out-of-the-box low cost vehicle tracking solution: hardware, software and maps, ready to track. AVL is a combination of GPS and GIS with communications links added to track, locates, and log fleet vehicles. Customer service is improved by increased on-time deliveries, and faster response to customer pickup requests using AVL locate and send nearest vehicles functions. Track your fleet from your desktop with a low cost fully featured GIS-based map display and AVL system that allows you to track your vehicle real-time on detailed street maps. Benefits of the AVL system that have been applied:

- Kansas City achieved reduced incident-response time, from 7-15 to 2-3 minutes, with use of AVL.

• Provides graphic or tabular report of vehicle activity (i.e., dwell time, speed).
• Sweetwater County, WY, almost doubled ridership without increasing dispatching staff by implementing AVL and CADS. Operating expenses decreased 50% per passenger mile.
• AVL and CADS allowed St. John's County Council on Aging in Augustine, FL, to reduce its scheduling, dispatching, and billing staff by half. Trips per vehicle hour have increased from 0.5 to 2.5.
• Collects driver log for use by payroll.
• Provides graphic or tabular report of vehicle activity (i.e., dwell time, speed).

DESIGN: Vehicle Accident SMS Alert with GPS Location Notification

In the design paper, Vehicle Accident SMS Alert with GPS Location Notification by Joshua Borja Cuesta, Maricar Ternida, Eugene Ancheta, Jessica Bernardino and Dexter Nidoy, the development of their design also mainly focuses on vehicular Accidents containing a SMS Module for the sending of accident notification and a GPS Module that determines the location of the accident.

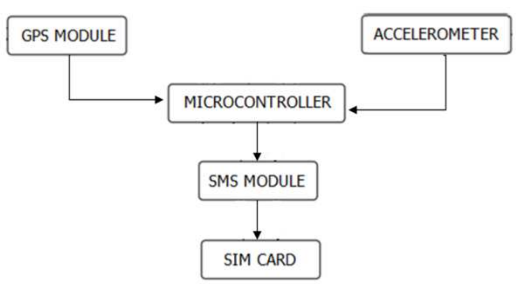


Figure 2.3 Block diagram of the Design Vehicle Accident SMS Alert with GPS Location Notification

Based from the given block diagram in Figure 2.3, the accelerometer serves as a sensor that shall be mounted on to the vehicle, this sensor shall detect inclination and movement of the vehicle. As programmed in the Microcontroller any strong impact or sudden brakes will trigger the an instruction to the microcontroller and immediately activating the SMS Module to send out the alert notification. The GPS module shall be responsible for the accident's location which will be also sent out. The SMS Module contains the SIM card fthat shall sent out the message, also taking note that it should have enough Load or balance to sent out the message.

Based from the design, the Accident alert notification system mainly bases its action on the accelerometer's angle of inclination and sensitivity. Using this related literature, the group used most of the concept of the design for the monitoring of Vehicular Parametric Measurements and location status. Using this design we innovated and improved most of the feature as based from the recommendation given.

The difference of the two designs is that a Server and storage was added. A Server to monitor the vehicle from time to time and shall also act as a data storage for the LOCATION or ACCIDENT coordinates. While the VDIP Module was added for the USB Storage interfacing, the reason for the storage, as base from the recommendations found, is that their design needed storage for the sending of data. A SIM card is not enough to store the Vehicle's data location so a separate storage device was made. It is impractical since the storage of the cell phone isn't large enough to accommodate the data.

III. DESIGN PROCEDURES

A. *Hardware Development*

The group had used the related literature as cited in Chapter 2 about the whole idea of the design, with some major modification and altered improvements. This chapter gives a detailed discussion on how the step-by-step procedures will be used on the design in order to give the readers the idea on how the prototype has been created. This also helps the readers to easily understand on how the group contributed to be able to theorize the development of the design

Hardware Development

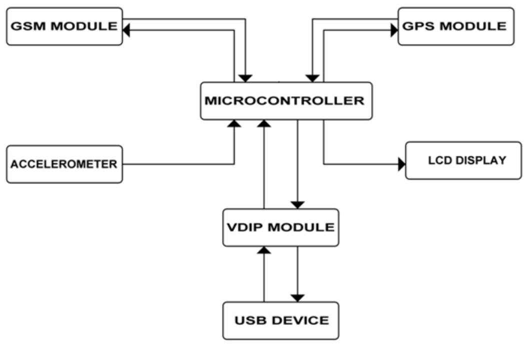


Figure 3.1

Figure 3.1 shows the block diagram which consists of the major parts of the device. This will help the readers to easily understand how the group came up with the design. It also shows the primary components of the device.

In developing the research, one must have full imagery on how the system is going to work. So the first step in doing the study is the development of the Block Diagram. In Figure 3.0, it can be seen that the whole system is dependent on the Microcontroller. The microcontroller shall serve as the main module of the design; it will control most of the device's functionality.

The GSM Module basically covers the whole concept of SMS alert. This module is only triggered when the accident occurs. This module is the ready solution for remote wireless applications, machine to machine or user to machine and remote data communications in all vertical market applications. GSM uses a process called circuit switching. This method of communication allows a path to be established between two devices. Once the two devices are connected, a constant stream of digital data is relayed. This allows the receiving end to hear the data being sent before the whole message or data were finished. The advantage to this is there's no wait time. In addition to the ignition control line, while the second strip contains all the communication signals and lines to and from the GSM module, as well as the analogical section of the phones

Next, the GPS module; this module composes of an antenna, that serves as the device's main feature for tracking. In this module, such unit must be used outdoors with a clear view of the sky, and are capable of locking into the signals from the GPS satellites. The signals allow them to calculate the distances to these satellites, and with that data they can calculate position on the earth's surface in latitude and longitude within +/- 100 meters 95 % of the time. This module is also called the user segment because; this part consists of user receivers which are hand-held or, can be placed in a vehicle. All GPS receivers have an almanac programmed into their computer, which tells where each satellite is at any given moment. The GPS receivers detect, decode and process the signals received from the satellites. The receiver is usually used in conjunction with computer software to output the information to the user in the form of a map. As the user does not have to communicate with the satellite there can be unlimited users at one time.

The VDIP Module is used to provide a USB interface. Hence gives the ease of program development for interfacing while providing the convenience of USB support. This interface shall serve as a pathway of connection from the USB storage device to the tracking device itself. The USB device, often referred to as a jump drive, works like a plug-n-play device. Files can be transferred quickly form one work station to another, as well as to other portable devices like laptops.

The next module to deal with is the Accelerometer, in this module it shall take responsibility of detecting the vehicle's movement and inclination. An accelerometer is an electromechanical device that will measure acceleration forces. These forces may be static, like the constant force of gravity pulling at your feet, or they could be dynamic - caused by moving or vibrating the accelerometer. It is a certain type of sensor, which is sensitive to movement, for this study it is the vehicle's. By sensing the amount of dynamic acceleration, one can analyze the way the device is moving.

And lastly, the main processing unit of the whole tracking device is the Microcontroller, the functions of the this controls all the modules connected to it, the GSM, GSP, VDIP modules. The Microcontroller shall contain the instructions that shall be passed into each module upon operation of the device. This shall be programmed as to acquire the specific requirements of the design.

After studying the block diagram's main picture, next step is design the Tracking and Vehicular Monitoring device from the block diagram. In order for the device to become functional, or more importantly be built, one must first be familiar with the physical and

complex structure of the vehicle into which the device shall be mounted. Once that had been studied thoroughly, next to build is the individual module of the device. The GPS, GSM, VDIP and Accelerometer Module are to be designed individually so as not to complicate the circuit. The Microcontroller shall be programmed as to incorporate these modules.

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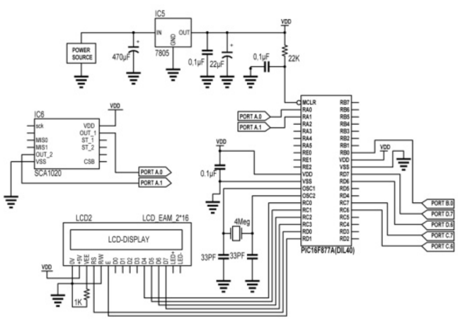

Figure 3.1
Schematic Diagram of Microcontroller

Figure 3.2 shows the Microcontroller's Module. In this module, the Microncontroller shall serve as the Brain of the device. The Microcontroller comprises of different instruction inputted anc coded into it. Most of the instrcutions involved are each of the other modules' operation. In the Figure 3.2, as shown in order to check whether all other modules are responding, a LCD was connected so as to monitor the device's initalization process. Based from the data sheet provided, the connection from the microcntroller to the LCD to the Pin labels RC1, RC2, RC3, RD1 and RD0 to the LCD's Pin labels D4, D5, D6, D7, E and RS respectiveley. This connection shall output the Initialization of each modules. Since the program has already been encoded, and the corresponding Message shall be outputted on LCD Screen. The LCD basically is used for checking the initialization of each module. It shall output if the initialization was successful or has failed. Another output message shall be shown when the car has been in an accident, since the device had been program to freeze when the accident occurs, the LCD shall display a Locked down Message saying Accident. After that the device had to be reset in order for it to work again.

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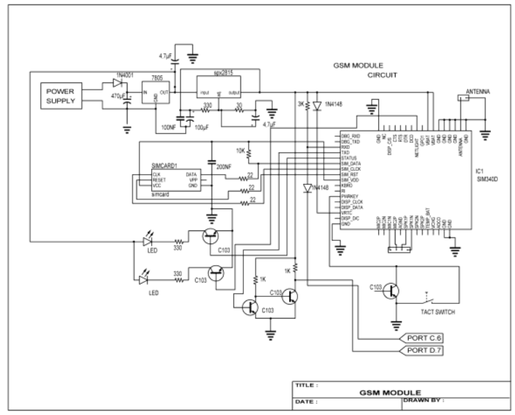

Figure 3.2
Schematic Diagram for GSM Module

The GSM module is resposible for the sending of message to the Server. The occurance of an accident or location updating shall be sent. As can be seen in the figure, the module uses GSM module and the IC SIM900D. On SIM900D, the SIM_DATA, SIM_CLK AND SIM_RST are directly connected to the SIM when it is properly placed on the module. Because of this, it allows the SIM card to access the GSM module. In the figure, the MIC1N, MIC2P, SPK1P AND SPK1N are also connected to it, so that the user can use the function call. The LED indicates if the GSM module is power on and has a signal. As seen in Figure 3.3, the whole circuit basically acts like a cellphone but instead of the manual sending of the message, the microcontroller's instruction shall command the GSM to keep sending messages every 3 seconds. And of course, along the circutry is the SIM card slot, a SIM card is needed in order to send the message provided that a SIM has enough load to send the messages. The SIM card Provider used for the circutry is Globe Telecoms, this provider was used because of its easy programmable receiver (Globe Tattoo).

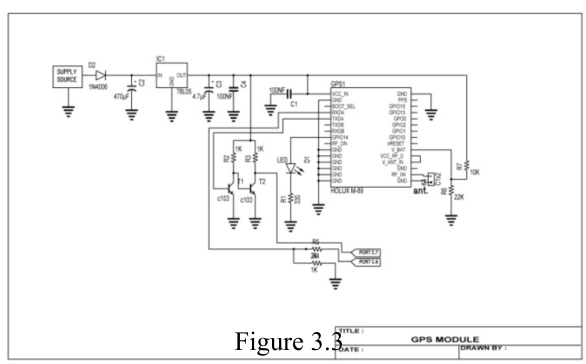

Figure 3.3

Schematic for GPS Module

The GPS module used was a GR-98, as stated early, it will be responsible for the vehicle’s parametric location. In Figure3.4, it shows the whole circuit connection of the GPS alone, an antenna is connected on the circuit (RF-IN and GND) so as to receive the Signal. The LED shall serve as an indicator to determine if the GPS module is working. If the LED continuosly lights, it indicates that no signal is received but once the LED starts blinking, then the module had picked up a signal. The LED is connected, as based from the diagram, on the Pin Label GPIO14, this pin is used to detect the signal being transmitted into the module, once detected the component connected on it (for this circuit is the LED) shall output the corresponding action.

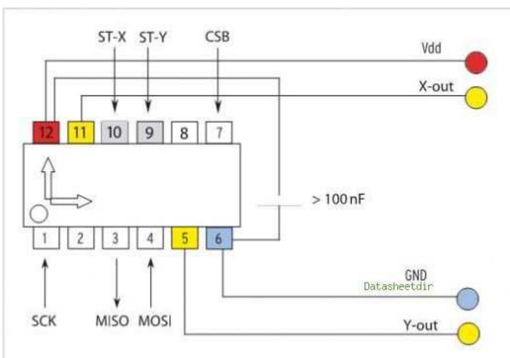

Figure 3. 4
Schematic for Accelerometer

The type of Accelerometer used is a SCA1020, this accelerometer is sensitive to movement. Based on Figure 3.5, the arrow basically indicates the direction of the accelerometer. This is the based direction from which the device shall be dependent on. If ever the car had entered into an accident, the accelerometer’s program direction of the arrow will be disaligned, thus triggering the GSM module that the acident has occured. ST-Y and ST-X are the self test pins so as to know the so called coordinates that serve as the accelerometers input for detecting movement. The MISO and MOSI serve as the the input-output of data.

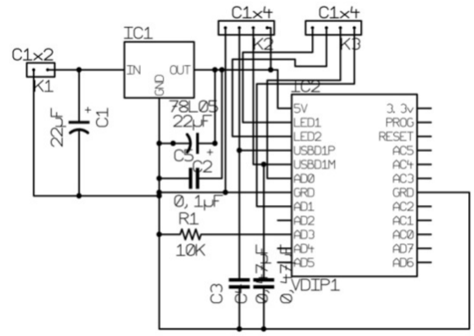

Figure 3.5
Schematic for VDIP Module

The VDIP module used for the desugn is a VDIP1 FTDI module. This module comes with a mounting interfaces so as to avoid the damagingof the pins. This module shall serve as the USB interface for which the recording of the Vehicle’s activities shall be generated on the USB. The microcontroller has been program to generate a LOG text file that shall record the Vehicle’s activities, the VDIP module’s role is to connect the USB device so as to allow data to be recorded onto it.

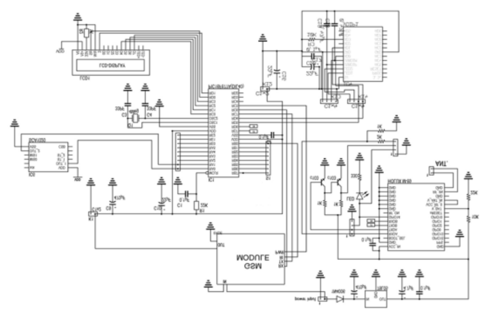

Figure 3.6
Schaematic Diagram for the combined module of the design

Figure 3.6 shows the overall connection of each module into the microcontroller. If one would observe, each module (VDIP, GPS, GSM) are independent to one another. So if one module is not responding the rest of the Modules will be left in a Hanging State, meaning all modules would not be responsive.

IV. Software Development

The microcontroller has the big part on the prototype because the entire program is saved on it. In this system development, the group shows the process on how the system works.

First, he configures the devices like the USB, GSM and the GPS. When all initialization and configuration are done, he tests the whole system if it is working. The group tries to drive the toy car; if no accidents have taken place, reset the system. While if an accident happens the coordinates of the location and the time of the accident would be stored in the flash drive. If the system confirmed that an accident happened an SMS would be transmitted. If an SMS would be sent, the system would initialize the SMS to send a message to the subscriber indicating that an accident happened. Simultaneously the GPRS would also send the information needed by the subscriber.

Figure 3.8 shows the Program Flowchart. The Program flowchart is one of the tools that can help the readers to understand on how the design works. After the device has been turned on, initialization takes effect on the system.

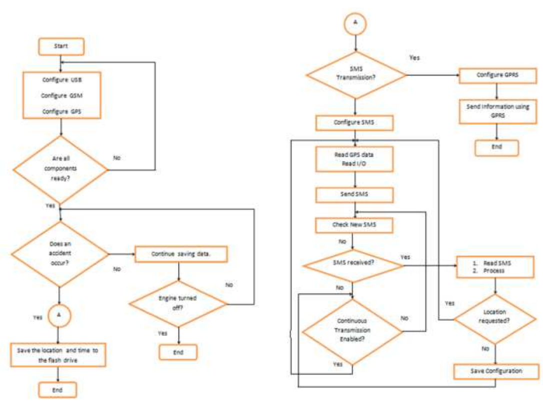

Figure 3. Program Flowchart

V. Prototype Development

Once the discussion of the hardware and software development part was elaborated, the group came up with the groundwork of the materials and components in order to build the device along with the process on how to incorporate the materials and modules.

By showing all the materials and components that were used for the device in Table 3., the readers will understand how the group came up and built the desired design for the prototype.

Component w/ Specification	**Quantity**	**Price per Unit**	**Total Amount**
LCD (4x20)	1	P800.00	P800.00
GPS	1	P5,500.00	P5,500.00
GPS antenna	1	P2,500.00	P2,500.00
Capacitor (0.1	2	P4.00	P8.00
Capacitor 16V (470 microF)	1	P20.00	P20.00
Capacitor 35V (22 microF)	2	P20.00	P40.00
Capacitor 16V (33pF)	2	P1.50	P3.00
Capacitor 16V (10 microF)	1	P10.00	P10.00
Resistor ¼ W(22k)	2	P1.00	P2.00
MAX 232	1	P50.00	P50.00
IC Socket (16 pin)	2	P6.00	P12.00
IC Socket (40 pin)	1	P15.00	P15.00
Battery Holder	1	P10.50	P10.50
PIC16F877	1	P275.00	P275.00
Crystal Oscillator 3.92	1	P20.00	P20.00
8-pin Connection Male and Female	1	P25.00	P25.00
2-pin Connection Male and Female	2	P6.00	P12.00
Accelerometer	1	P2700.00	P2700.00
LED	1	P2.50	P2.50

Diode 4148	1	P1.50	P1.50
Alligator Clip	2	P5.00	P10.00
Battery 9V	1	P65.00	P65.00
Serial Connector DB9	2	P25.00	P50.00
Battery Clip	1	P5.00	P5.00
SMS Module	1	P5,500.00	P5,500.00
LCD 2x16	1	P450.00	P450.00
DB SUB9	1	P19.00	P19.00
Casing	1	P50.00	P50.00
Switch On/off	1	P 20.00	P 20.00
VDIP Module	1	P 4000.00	P 4000.00

1. An **accelerometer** is a device that measures the vibration, or acceleration of motion of a structure.
2. A **decoupling capacitor** is a capacitor used to decouple one part of an electrical network (circuit) from another.
3. The **Global Positioning System (GPS)** is a space-based global navigation satellite system(GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites.
4. A **liquid crystal display (LCD)** is a flat panel display, electronic visual display, video display that uses the light modulating properties of liquid crystals (LCs).
5. **A microcontroller (PIC16F877A)** is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals.
6. A **Regulator**, a device that maintains a designated characteristic
7. A **serial port** is a serial communication physical interface through which information transfers in or out one bit at a time.
8. A **Short Message Service (SMS)** is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices.
9. A **parallel port** is a type of interface found on computers for connecting various peripherals
10. A **USB (Universal Serial Bus)** is an industry standard developed in the mid-1990s that defines the cables, connectors and protocols used for connection, communication and power supply between computers and electronic devices.
11. A **voltage divider (also known as a potential divider)** is a simple linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in})

12. **PCB** also known as the printed circuit board, where the components are being attached to it.

VI. TESTING, PRESENTATION, AND INTERPRETATION OF DATA

Impact Analysis

By this innovation, the Company is able to secure their products/produces in terms of delivery services. When a company knows that their employees are trustworthy enough to do the job, they are much more secured in letting them handle their product/produce. And also the company is able to monitor their employees' activity even when they are on the road. This innovated tracking device system also helps solve the cause of common car accidents by letting one know exactly what happened before and after the accident occurs. Another benefit is the updating of information. Sometimes in

isolated area where accidents sometimes happen, help response come in late to save a life, by this design, the researchers used the GPS and SMS technology to be triggered once the accident happened and to send the information immediately to the server to alert that help is needed.

The tracking of vehicles by means of GPS receivers has recreational, economical and safety benefits in society. GPS equipped rental cars can provide tourists with driving instructions to tourist sites, and accommodation. This can reduce stress levels whilst on vacation. Truck drivers are now being made aware of upcoming low bridges using GPS and digital maps. This combined with awareness of traffic jams, and suggestions of alternative routes allows for the cheaper delivery of goods. Police cars, ambulances and fire trucks are also increasingly being fitted with GPS. This allows emergency operators to direct the closest units to an emergency, potentially saving lives.

With GPS technology, the routes of the test persons are linked up with the purpose of the journey. In such a way, a database can be created where the proportion of trips for shopping can be separated from other journeys. One can then also see how common it is for journeys to shops to be combined with other journeys, for instance journeys to and from work, to and from school or to and from recreational activities.

GPS Testing

The purpose of this test is to determine if the GPS unit will be able to initialize without difficulty in getting signal. Another test should be made with the use of the design itself- a blinking LED will serve as an indicator of the status of the GPS, an LCD that will display a value of 1 or 0 that serves as the representation of the status of the GPS and will display the coordinates taken. If the GPS status is equivalent to 1, this indicates that the GPS is ready for testing and a status of 0 means that the GPS is still initializing. Before conducting the tests, the program for the GPS should be run and would be taken from the Google Maps in the internet. The coordinates will be given in North-East format and the location will be pointed in the site. Mapua Institute of Technology is the location used for testing of the device. The table (Table 4.1) below shall be used to conduct the summarization of the results.

Trial	Weather Condition	Type of Device Location	GPS Initializing Time	LCD Display
Trial 1	Heavy rains	Closed Area	Did not initialize	GPS = 0
Trial 2	Heavy rains	Open Area	5 mins	N,14.5902 E,120.9768
Trial 3	Sunny	Closed Area	1.8 mins	N,14.5902 E,120.9773
Trial 4	Sunny	Open Area	1 min.	N,14.5904 E,120.9771
Trial 5	Cloudy	Open Area	1.20 mins	N,14.5902 E,120.9768
Trial 6	Cloudy	Open Area	1.10 mins	N,14.5904 E,120.9775
Trial 7	Cloudy	Open Area	1 min.	N,14.5884 E,120.9798
Trial 8	Cloudy	Open Area	1.50 mins.	N,14.5892 E,120.9790
Trial 9	Cloudy	Open Area	1.50 mins.	N,14.5899 E,120.9783
Trial 10	Cloudy	Open Area	1.45 mins.	N,14.5905 E,120.9777
Trial 11	Cloudy	Open Area	1min	N,14.5905 E,120.9778
Trial 12	Sunny	Open Area	0.50 mins.	N,14.5905 E,120.9778
Trial 13	Sunny	Open Area	0.45 mins.	N,14.5908 E,120.

				9777
Trial 14	Sunny	Open Area	1 min.	N,14.5 908 E,120. 9777
Trial 15	Sunny	Open Area	0.48 mins.	N,14.5 908 E,120. 9777
Trial 16	Sunny	Closed Area	1.7 mins	N,14.5 908 E,120. 9779
Trial 17	Sunny	Closed Area	1.8min s	N,14.5 910 E,120. 9776
Trial 18	Sunny	Closed Area	1.50 mins	N,14.5 904 E,120. 9782
Trial 19	Sunny	Closed Area	1.50 mins.	N,14.5 903 E,120. 9782
Trial 20	Sunny	Closed Area	1.8min s	N,14.5 906 E,120. 9781
Trial 21	Sunny	Closed Area	1.8min s	N,14.5 908 E,120. 9780
Trial 22	Cloudy	Closed Area	2 mins.	N,14.5 902 E,120. 9768
Trial 23	Cloudy	Closed Area	2 mins.	N,14.5 899 E,120. 9789
Trial 24	Cloudy	Closed Area	2 mins.	N,14.5 904 E,120. 9779
Trial 25	Heavy rains	Open Area	3.45 mins.	N,14.5 914 E,120. 9777
Trial 26	Heavy rains	Open Area	4.5 mins.	N,14.5 912 E,120. 9780
Trial 27	Heavy rains	Closed Area	Did not initializ e	GPS = 0
Trial 28	Heavy rains	Closed Area	Did not initializ e	GPS = 0
Trial 29	Heavy rains	Closed Area	Did not initializ e	GPS = 0
Trial 30	Heavy rains	Closed Area	Did not initializ e	GPS = 0

Table 4.1 Testing for the operation of the Global Positioning System (GPS)

Based on the results, the initialization of the GPS depends on the signal gathered by the antenna. Weather condition and type of location may affect its initialization. The table shows that if the weather is good and operated in an open area, the GPS module will initialize at an estimated time of 1 minute while in a closed area, a small discrepancy on initializing time is observed. Also, if the weather condition is rainy and tested on a closed area, the device will not initialize because of some difficulties in gathering signals.

VDIP Module Testing

The role of the VDIP module is to record and store the data on the server and on the USB device. Order to check whether data had been recorded, series of activities that the vehicle would do (example: start engine, break, speed up, etc.) shall be conducted. After the testing, the data shall be compared with the number of activities done by the vehicle with the number of activities recorded onto the USB device. This comparison test shall check whether the Microcontroller had been programmed as to the expected outcome.

Trials	Device	Location	Remarks
Trial 1	Vehicle	N,14.59 02 E,120.9 768	Same data

	USB Device	N,14.5902 E,120.9768	
Trial 2	Vehicle	N,14.5902 E,120.9773	Same data
	USB Device	N,14.5902 E,120.9773	
Trial 3	Vehicle	N,14.5904 E,120.9771	Same data
	USB Device	N,14.5904 E,120.9771	
Trial 4	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 5	Vehicle	N,14.5884 E,120.9798	Same data
	USB Device	N,14.5884 E,120.9798	
Trial 6	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 7	Vehicle	N,14.5904 E,120.9775	Same data
	USB Device	N,14.5904 E,120.9775	
Trial 8	Vehicle	N,14.5904 E,120.9	Same data

		771	
	USB Device	N,14.5904 E,120.9771	
Trial 9	Vehicle	N,14.5901 E,120.9773	Same data
	USB Device	N,14.5901 E,120.9773	
Trial 10	Vehicle	N,14.5902 E,120.9772	Same data
	USB Device	N,14.5902 E,120.9772	
Trial 11	Vehicle	N,14.5903 E,120.9771	Same data
	USB Device	N,14.5903 E,120.9771	
Trial 12	Vehicle	N,14.5904 E,120.9772	Same data
	USB Device	N,14.5904 E,120.9772	
Trial 13	Vehicle	N,14.5903 E,120.9772	Same data
	USB Device	N,14.5903 E,120.9772	
Trial 14	Vehicle	N,14.5902 E,120.9773	Same data
	USB Device	N,14.5902 E,120.9773	

Trial 15	Vehicle	N,14.5902 E,120.9768	Same data
	USB Device	N,14.5902 E,120.9768	
Trial 16	Vehicle	N,14.5904 E,120.9783	Same data
	USB Device	N,14.5904 E,120.9783	
Trial 17	Vehicle	N,14.5905 E,120.9782	Same data
	USB Device	N,14.5905 E,120.9782	
Trial 18	Vehicle	N,14.5906 E,120.9779	Same data
	USB Device	N,14.5906 E,120.9779	
Trial 19	Vehicle	N,14.5907 E,120.9775	Same data
	USB Device	N,14.5907 E,120.9775	
Trial 20	Vehicle	N,14.5906 E,120.9781	Same data
	USB Device	N,14.5906 E,120.9781	
Trial 21	Vehicle	N,14.5903 E,120.9776	Same data
	USB Device	N,14.5903 E,120.9776	
Trial 22	Vehicle	N,14.5904 E,120.9777	Same data
	USB Device	N,14.5904 E,120.9777	
Trial 23	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	
Trial 24	Vehicle	N,14.5904 E,120.9777	Same data
	USB Device	N,14.5904 E,120.9777	
Trial 25	Vehicle	N,14.5900 E,120.9778	Same data
	USB Device	N,14.5900 E,120.9778	
Trial 26	Vehicle	N,14.5905 E,120.9776	Same data
	USB Device	N,14.5905 E,120.9776	
Trial 27	Vehicle	N,14.5900 E,120.9778	Same data
	USB Device	N,14.5900 E,120.9778	
Trial 28	Vehicle	N,14.5900 E,120.9778	Same data

	USB Device	N,14.5900 E,120.9778	
Trial 29	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	
Trial 30	Vehicle	N,14.5907 E,120.9777	Same data
	USB Device	N,14.5907 E,120.9777	

Table 4.2 VDIP Module Testing

The test for the VDIP module is simply checking if the activities recorded by the vehicle are equal with the data stored in the USB device. The table shows that the activities of the vehicle are equal to the activities stored on the USB device.

GSM Module Testing

The SMS testing shall be made on the GSM module, since one of the objectives of the design is to provide accurate and early information if an accident had occurred. This module is used to check whether the receiver had received the default SMS, once the accident had occurred. The data shall be expected with an imprecise result since the sending and receiving of the message is entirely dependent on the service provider and the signal. The testing is simple, just trigger the GSM Module as if an accident had occurred then test whether the message had been received or not. This sort of testing shall check the functionality of the GSM Module. In order to check this, the Server shall be used. The Server is responsible for monitoring of the GPS and GSM Module. The table (Table 4.3) shall be used to record the results.

Trial	Sending (Sent/Fail)	Receiving (Received/Failed/Delayed)
Trial 1	Sent	Received
Trail 2	Sent	Received
Trial 3	Sent	Received
Trial 4	Sent	Received
Trial 5	Sent	Received
Trial 6	Failed	Failed
Trial 7	Failed	Failed
Trial 8	Failed	Failed
Trial 9	Sent	Delayed
Trial 10	Sent	Delayed
Trial 11	Sent	Delayed
Trial 12	Sent	Delayed
Trial 13	Sent	Delayed
Trial 14	Sent	Delayed
Trial 15	Sent	Delayed
Trial 16	Sent	Received
Trial 17	Sent	Received
Trial 18	Sent	Received
Trial 19	Sent	Received
Trial 20	Sent	Received
Trial 21	Sent	Received

Trial 22	Sent	Received
Trial 23	Sent	Received
Trial 24	Sent	Received
Trial 25	Sent	Received
Trial 26	Sent	Received
Trial 27	Sent	Received
Trial 28	Sent	Received
Trial 29	Sent	Received
Trial 30	Sent	Received

Table 4.3 GSM Module Testing

Based on the results, the data or messages that were sent were received on time because of the high signal. Some messages that were sent were delayed because of the low signal and some problems from the service provider. Also, the sim card used should have an amount of load that can support its texting or transferring of data or else it will fail.

Accelerometer Testing

The accelerometer's sensitivity is triggered by the movement of the vehicle, it shall be noted on what position the accelerometer will detect the vehicle's movement and quickly transfer the data for recording. The accelerometer shall run series of trials to see how fast it can detect sudden change of movement. The Table 4.4 shall be used for the testing of the module.

Trial	Accelerometer Reading		Remarks
	X-coordinates	Y-coordinates	
Trial 1	+1 g position	0 g position	No accident occurred
Trial 2	-1 g position	0 g position	Accident occurred
Trial 3	0 g position	+1 g position	Accident occurred
Trial 4	0 g position	-1 g position	Accident occurred
Trial 5	0 g position	+1 g position	Accident occurred
Trial 6	0 g position	+1 g position	Accident occurred
Trial 7	0 g position	+1 g position	Accident occurred
Trial 8	+1 g position	0 g position	No accident occurred
Trial 9	+1 g position	0 g position	No accident occurred
Trial 10	-1 g position	0 g position	Accident occurred
Trial 11	0 g position	+1 g position	Accident occurred
Trial 12	+1 g position	0 g position	No accident occurred
Trial 13	+1 g position	0 g position	No accident occurred
Trial 14	-1 g position	0 g position	Accident occurred
Trial 15	-1 g position	0 g position	Accident occurred
Trial 16	+1 g position	0 g position	No accident occurred
Trial 17	-1 g position	0 g position	Accident occurred
Trial 18	0 g position	+1 g position	Accident occurred
Trial 19	+1 g position	0 g position	No accident occurred
Trial 20	+1 g position	0 g position	No accident occurred
Trial 21	-1 g position	0 g position	Accident occurred
Trial 22	0 g position	+1 g position	Accident occurred
Trial 23	+1 g position	0 g position	No accident occurred
Trial 24	+1 g position	0 g position	No accident occurred
Trial 25	-1 g position	0 g position	Accident occurred

Trial 26	0 g position	+1 g position	Accident occurred
Trial 27	+1 g position	0 g position	No accident occurred
Trial 28	+1 g position	0 g position	No accident occurred
Trial 29	+1 g position	0 g position	No accident occurred
Trial 30	+1 g position	0 g position	No accident occurred

Table 4.4 Accelerometer Testing

Table 4.4 shows the different position of the accelerometer that can be seen on its datasheet. The result shown above determines when an accident may occur according to the position of the accelerometer in X – Y format.

VII. CONCLUSIONS AND RECOMMENDATION

This chapter gives the overall conclusion of the design covering up all the objectives specified in Chapter 1. This chapter also covers the important results of the test performed in Chapter 4 including the delimitations of the design. The recommendation part of this chapter suggests what should be done to improve the design.

A. *Conclusion*

Global positioning system is a global satellite navigational system, which enables tracking down the location and many other important details of assets like vehicles, cargo containers, etc. At present, besides tracking down the vehicle's location, the technology is used for performing hosts of military applications, medical applications, etc.

The development of the design was made so as to ensure that a company will be able to monitor their vehicle so as to determine whether it has been utilized properly and had not undergone illegal transaction that is unknown to the company. The design was also developed in order to decrease the rising number of road accidents that occur. More than 10% of the world's population dies of road accident each year.

Recording the activities that the vehicle had made the whole day makes it easier to analyze and determine data. Using the collected data can help minimize false guessing of where the vehicle might have gone. The data are very crucial part of monitoring the device. Without such data, the driver can easily declare that he had done his job right, or declare that the car was under the company business transaction, in which may turn out to be lie.

A final conclusion to state is that GPS vehicular tracking system is a very effective technology that has made possible to perform the business operations with complete security. Monitoring the vehicle makes the user or individual become fully aware of his time managerial on the road, the daily routes he should take for better.

Knowing the places on which the vehicle has gone makes it easier to know whether the vehicle has any business on that area. Whether it is legal or not, the location is a huge factor in monitoring the vehicle's activities.

B. *Recommendation*

This design can be improved for further studies. For one, the design was specifically made for everyday used cars and vehicles. The design can be further enhanced so as to accommodate manual and automatic cars.

The design was made as whole component, meaning that each module was designed so as to be dependent on the other modules. When one module fails to initialize properly (more commonly the GPS Module due to signal problems) the other modules hang or no longer responding. The design could use some improvements on the module independency.

Another improvement that can be made is creating a reset button in case the device has not responded or has already undergone a lock down when the accident occurs.

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